GUIDE LEAFLET 1971-D

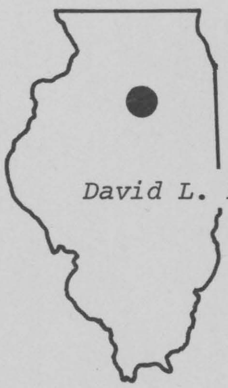
GUIDE LEAFLET

GEOLOGICAL SCIENCE FIELD TRIP

LA SALLE AREA

La Salle, Bureau, and Putnam Counties

La Salle and Ottawa 15-Minute Quadrangles



David L. Reinertsen and Myrna M. Killey

Host—La Salle-Peru High School *September 11, 1971, and May 20, 1972*

Sponsored by the
ILLINOIS STATE GEOLOGICAL SURVEY *Urbana 61801*

TO THE PARTICIPANTS:

The Geological Science Field Trip program is designed to acquaint Illinois residents with the landscape, the rock and mineral resources, and the geological processes that have led to their origin. With this program, we hope to stimulate a general interest in the geology of Illinois and a greater appreciation of the state's vast mineral resources and their importance to the over-all economy.

We encourage you to ask the tour leaders any questions that may occur to you during the trip. Discussion often clarifies points that otherwise would remain confused to many of the participants. We also invite your written comments upon the conduct of the trips so that we might improve them as much as possible.

Additional copies of this guide leaflet, as well as itineraries for field trips that have been held in the past, may be obtained free of charge by writing to the Illinois State Geological Survey. The itinerary maps for each field trip can be purchased for 10 cents each.

Several of the stops along this itinerary are located on private property whose owners have graciously given us permission to visit their lands. Please obey the instructions of your trip leaders and conduct yourselves in a manner that will show respect for the property owners' cooperation. Please do not litter, or climb on fences, and leave all gates as found, so that we may be welcome to return on future field trips. These simple rules of courtesy also apply to public property as well. For the convenience of those persons who may use this itinerary at some future time, the names and addresses of every private property owner are listed for the respective stops on a page at the back of this guide leaflet. Whenever possible, always attempt to obtain permission when visiting private property.

We hope that you enjoy today's field trip and will attend others in the future.

THE STAFF
EDUCATIONAL EXTENSION SECTION
ILLINOIS STATE GEOLOGICAL SURVEY

LA SALLE GEOLOGICAL SCIENCE FIELD TRIP

Introduction

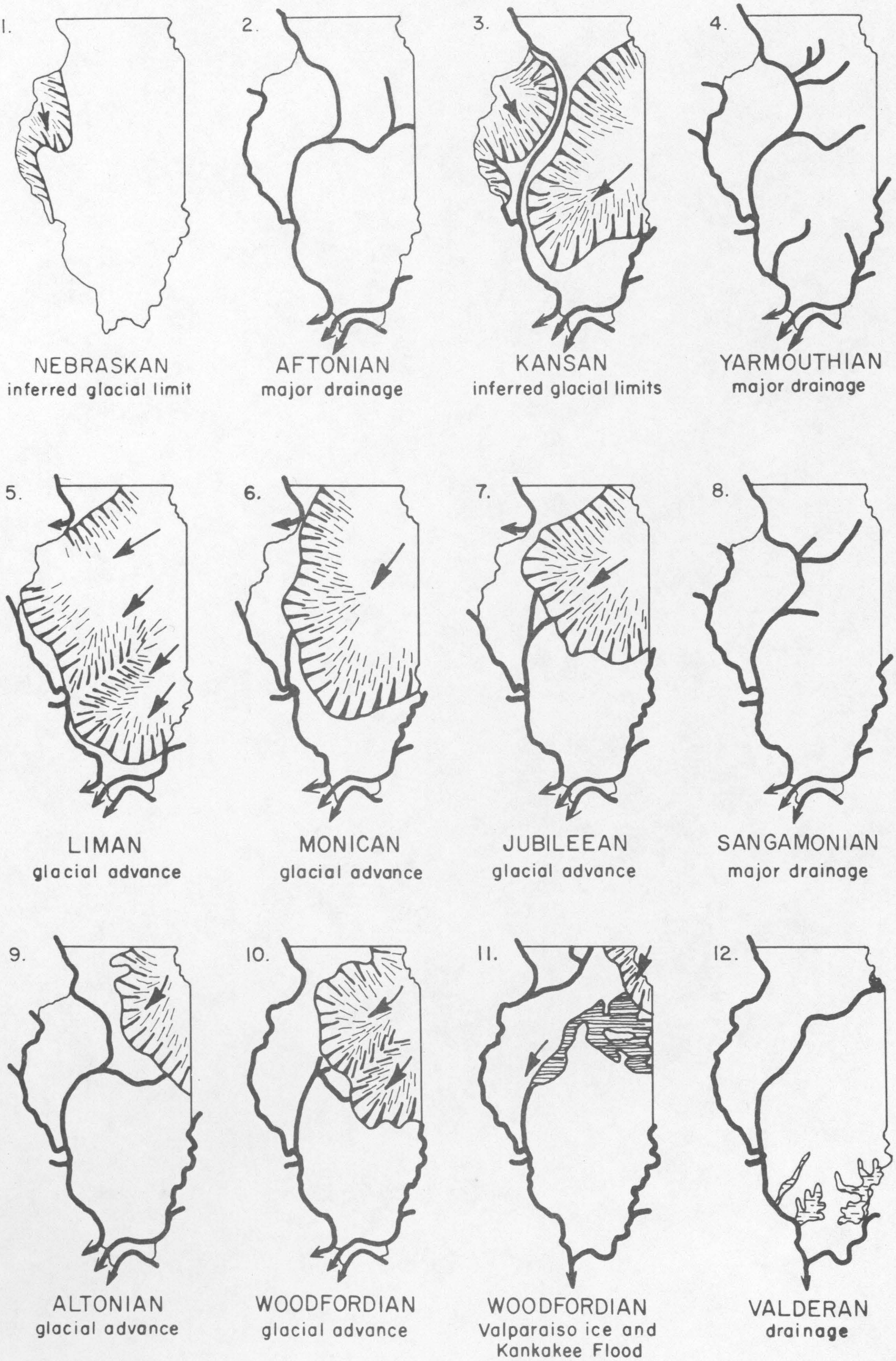
The La Salle area in northern Illinois lies along the scenic bluffs of the Illinois Valley in La Salle County. The area was covered by continental ice sheets during the Kansan, Illinoian, and Wisconsinan glaciations, the second, third, and fourth intervals, respectively, of the "Great Ice Age" (note diagram showing sequence of glaciations on following page). Accumulations of Kansan drift, deposited between 700,000 and 600,000 years ago, and of Illinoian drift, deposited between 250,000 and 200,000 years ago, are preserved only in preglacial and early Pleistocene bedrock channels because each succeeding glacier eroded these drifts off the bedrock surface in the interstream areas. Wisconsinan deposits (Farmdalian Substage silts) accumulated as early as 27,500 years ago in this region. Isolated occurrences of these silts have been studied beneath the Woodfordian drifts (Shelbyville moraine and younger), which were deposited 20,000 to 12,500 years ago.

Physiographically, the field trip area is in the northern part of the Bloomington Ridged Plain, a region of relatively low, broad, glacial moraine ridges separated by wide areas of comparatively flat or gently undulating groundmoraine (see attached map of Physiographic Divisions of Illinois). The present topography of the La Salle area is mainly the result of the deposition of drift by Wisconsinan glaciers and the subsequent erosion and dissection of these deposits by streams during late Wisconsinan and post-Wisconsinan times. Although glacial deposits are very thin along the Illinois River bluffs, the drift does thicken to 50 to 100 feet a short distance from the bluffs. Irregularities in the bedrock surface have little or no influence on the topography where the drift is thick. The Illinois Valley is the most prominent topographic feature in the field trip area, its narrow, rock-walled valley contrasting sharply with the undulating upland terrain. The highest surface elevations, slightly over 740 feet above sea level, are found in the southwestern corner of the area shown on the field trip map, and the lowest elevation, about 455 feet, is where the Illinois River leaves the mapped area on the west. The maximum relief, therefore, is 280 to 290 feet within a distance of about 1.8 miles.

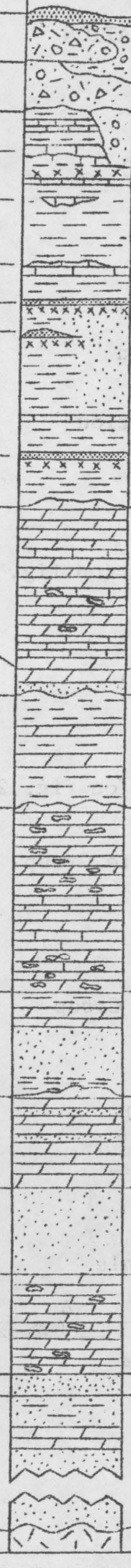
The much older, consolidated bedrock that underlies the glacial deposits in the La Salle area consists of 4,000 to 4,700 feet of sedimentary strata (fig. 1). The thickness varies, depending on the configuration (buried surface relief) of the deep underlying Precambrian crystalline rocks. These strata consist mainly of sandstone, shale, dolomite, and limestone that were deposited layer upon layer in the shallow ancient seas that invaded the midcontinent region during the Paleozoic Era, between 550 and 270 million years ago. The Paleozoic strata are divided into major subdivisions known as systems, each of which was deposited during a specific period of geologic time. The systems are subdivided into many formations based on mineral composition and fossil content. Exposures in the area reveal 900 to 950 feet of Ordovician and Pennsylvanian rocks (fig. 2, a and b). Formations of Devonian, Silurian, Ordovician, and Cambrian ages are known to be present from records and samples from deep wells that penetrate them and from exposures in other areas in Illinois. The lowest of the Cambrian strata rests on ancient basement Precambrian igneous and metamorphic rocks that are more than one billion years old.

Structurally, the La Salle area is on the northern shelf of the Illinois Basin, a large, spoon-shaped bedrock depression that underlies most of Illinois and adjacent parts of Indiana and Kentucky (figs. 3 and 4). The bedrock formations in the field trip area are tilted gently downward to the south and southeast, toward the deepest parts of the Illinois Basin. Locally, however, bedrock strata are inclined rather steeply, 25° to 35°, along the west limb of the La Salle Anticline.

SEQUENCE OF GLACIATIONS AND INTERGLACIAL
DRAINAGE IN ILLINOIS



(From Willman and Frye, "Pleistocene Stratigraphy of Illinois," ISGS Bull. 94, fig. 5, 1970.)



SYSTEM	SERIES	GROUP, STAGE	FORMATION	THICKNESS		GENERAL DESCRIPTION
QUATERNARY	Pleistocene	Wisconsinan		0-125'		Till, outwash, dune sand, loess, peat
					U	
QUATERNARY	Pleistocene	Illinoian - Kansan		0-100'		Till, outwash
					U	
PENNSYLVANIAN		McLeansboro	La Salle, Cramer, Lonsdale	0-700'		Alternating sequences of sandstone, shale, underclay, coal, and limestone
PENNSYLVANIAN		Kewanee	No. 7 Coal, No. 5 Coal, No. 2 Coal			
					U	
SILURIAN	Niag.		Racine, Waukesha, Joliet	400'		Dolomite with some limestone, cherty
SILURIAN	Alexandrian		Kankakee, Edgewood	60'		Dolomite and sandstone
					U	
ORDOVICIAN	Cin.	Maquoketa		180'		Shale, some dolomite or limestone
					U	
ORDOVICIAN	Champlainian	Galena - Platteville		335'		Dolomite, some limestone, cherty
ORDOVICIAN	Champlainian	Ancell	Glenwood - St. Peter	125-160'		Sandstone; little dolomite and shale at top
					U	
ORDOVICIAN	Canadian	Prairie du Chien	Shakopee	170-230'		Dolomite, some sandstone
ORDOVICIAN	Canadian	Prairie du Chien	New Richmond	80-188'		Sandstone
CAMBRIAN	Croixan	Prairie du Chien	Oneota	215'		Dolomite, cherty
CAMBRIAN	Croixan		Gunter	0-15'		Sandstone
CAMBRIAN	Croixan			2000-2500'		Sandstone, shale, dolomite
PRECAMBRIAN						Granite, gneiss, schist

Fig. 1 - Generalized geologic column of strata in the La Salle area. "U" indicates a major uncon-

EXPLANATION

QUATERNARY

Q (on fig. 2b only)

PENNSYLVANIAN

Bond Formation

Modesto Formation

Carbondale Formation

Spoon Formation

Pa Abbott Formation (on fig. 2b only)

SILURIAN

S (on fig. 2b only)

ORDOVICIAN

Om Maquoketa Group (on fig. 2b only)

Galena-Platteville Group

Ancell Group

Prairie du Chien Group

CAMBRIAN

€ (on fig. 2b only)

Map Scale

0 1 2 3 4 5 6

Miles

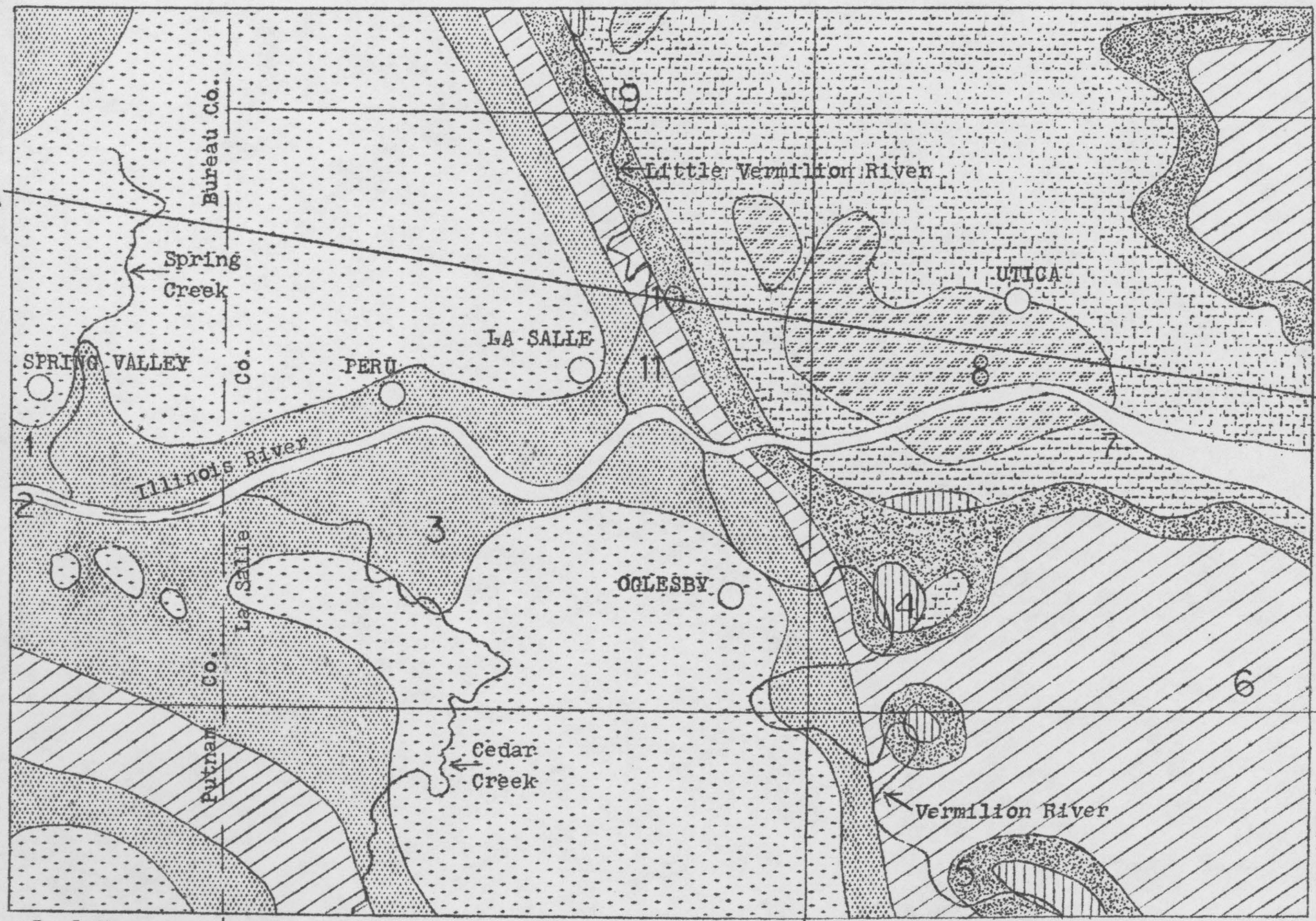


Fig. 2a - Geologic map of the bedrock formations in the La Salle area. Numbers on map refer to itinerary stops.

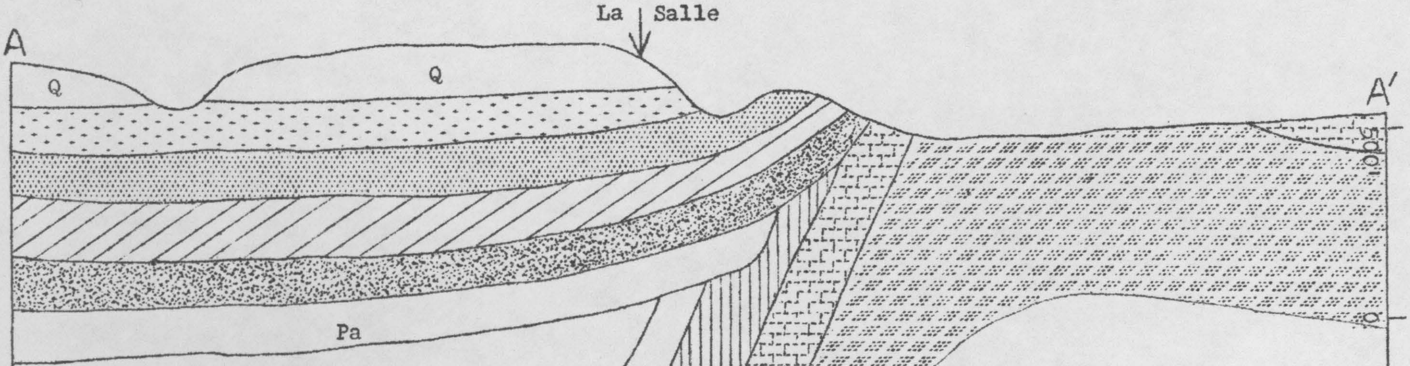


Fig. 2b - Generalized cross-section of the bedrock formations across the La Salle Anticline from west to east (A-A'). Only those formations shown with patterns outcrop on the geologic map shown in fig. 2a.

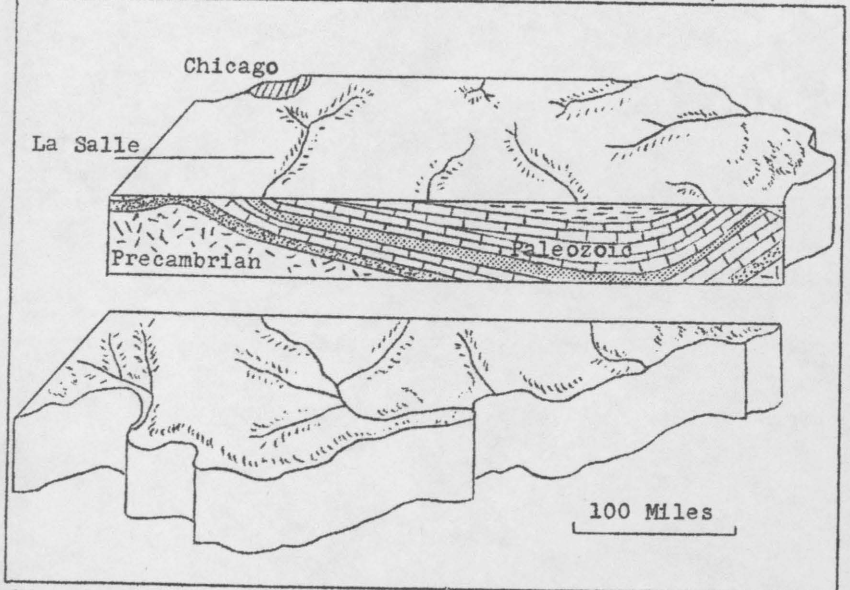


Fig. 3 - North-south cross-section through Illinois showing the Paleozoic strata in the Illinois Basin.

As the Illinois Basin was forming during the Paleozoic Era, it was also gradually filling with the Paleozoic sediments. Toward the deepest part of the basin in extreme southeastern Illinois, the Paleozoic rocks are more than 13,000 feet thick. The Pennsylvanian rocks are the youngest Paleozoic strata in the basin and may represent the last of the marine invasions during the Paleozoic Era. However, marine conditions probably persisted into the Permian Period, the sea finally withdrawing from the Illinois Basin for the last time at the end of the Paleozoic Era about 225 million years ago. Since then most of the region has remained above sea level and exposed to erosion. During this long erosional interval, all of the Permian strata and a considerable thickness of the Pennsylvanian have been removed. The nearest rocks of Permian age occur in eastern Kansas, 325 miles to the west.

Brief invasions of the sea reached northward from the Gulf of Mexico to submerge the southern tip of Illinois during the Cretaceous Period of the Mesozoic Era about 100 million years ago and again during the early part of the Tertiary Period of the Cenozoic Era about 60 million years ago (see attached Geologic Map of Illinois). These marine invasions did not reach as far as the La Salle area.

Glacial History of Illinois

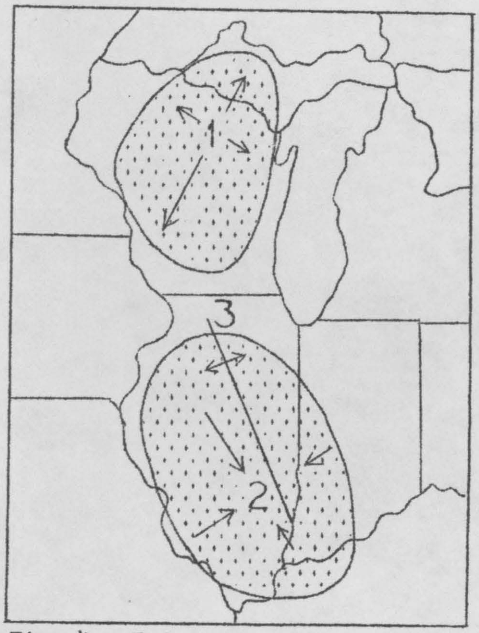


Fig. 4 - Index map showing locations of (1) the Wisconsin Arch, (2) the Illinois Basin, and (3) the axis of the La Salle Anticlinal Belt.

During the Pleistocene Epoch, commonly referred to as the "Great Ice Age," an extensive continental ice ap developed in the northern hemisphere when the mean annual temperatures were a few degrees cooler than they are now. The portion of the ice cap that intermittently covered northern North America has been named the Laurentide Ice Sheet. Beginning about 1,000,000 years ago and ending only 5,000 years ago, southward expansions of the ice sheet caused four major glacial invasions of Illinois and the Midwest. The ice that entered Illinois came from centers in central and eastern Canada (fig. 5). Each of the four major glacial advances were followed by long, warm interglacial intervals during which the glaciers melted completely (see attached Pleistocene Time Table). During these intervals, the deposits left by the glaciers were eroded and weathered. Each of the glacial advances produced significant changes in the topography and drainage of the glaciated areas. In order of occurrence, the glaciations of the Midwest have been named the Nebraskan, the Kansan, the Illinoian, and the Wisconsinan (see sequence of glaciations following page 1). The names are derived from the states where glacial

Fig. 5 - Maximum extent of the Laurentide Ice Sheet. The Keewatin (K) and the Labradorean (L) centers are shown.

deposits of these ages are best developed or were first described. The last glacier, the Wisconsinan, melted from northeastern Illinois a mere 12,500 years ago.

The Pleistocene glaciers profoundly modified the landscape of Illinois. They transported vast amounts of rock and soil debris eroded from the areas over which they moved. As the glaciers advanced and later melted, these materials, known as drift, were deposited. Within the areas once covered by the ice, there are extensive surficial deposits of ice-laid material called till. Areas that were glaciated several times may have more than one layer of till. Till is an unsorted, unstratified mixture of rock debris of all sizes that generally has the consistency of pebbly clay. Numerous arcuate till ridges called end moraines were formed at the margin of the Wisconsinan glacier in northeastern Illinois (see Glacial Map of Northeastern Illinois). Each end moraine represents an advance of the glacier and a line along which the ice margin maintained a temporarily fixed position. The moraines were built up by accumulation of rock debris carried forward to the melting ice front. Thinner deposits of till that form gently undulating plains between the end moraines are known as ground moraines or till plains.

Sorted and stratified waterlaid materials known as outwash, consisting of clay, silt, sand, and gravel, also resulted from the glaciations. Outwash sediments were deposited by debris-laden meltwater flowing away from the ice fronts during both the advances and retreats of the glaciers. Near the glacial margins, where meltwater was often not confined to definite channels, the outwash was laid as thin sheets called outwash plains. In some places, elongated ridges of sand and gravel, called eskers, represent channel deposits of meltwater streams that flowed on or under the glaciers. Conical mounds of outwash, called kames, were formed where meltwater plunged through crevasses in the ice or into ponds along the edge of the glacier. Glacial lakes formed by the ponding of meltwater in valleys, in low areas on till plains, and behind end moraines were also sites of deposition of the finest outwash sediments. Outwash deposits were often overridden by the advancing glaciers, so that the drift deposits typically consist of interstratified layers of till and outwash. There is also interfingering of these materials laterally.

River valleys, such as those of the Mississippi, Illinois, and Ohio, provided major channelways for escaping meltwaters. These valleys were greatly widened and deepened in the bedrock during the greatest meltwater floods. When the floodwaters were waning, the valleys far beyond the ice margins were partially filled with outwash. These outwash deposits, largely sand and gravel, are known as valley trains. For example, along much of its length, the valley train of the Mississippi Valley is more than 200 feet thick. In the La Salle area, the valley train of Wisconsinan outwash in the Illinois Valley is very patchy and thin, and most of it is found in tributary stream valleys. Many former river valleys in areas covered by the glaciers were completely filled and buried by glacial deposits. The meltwaters also cut new valleys and caused numerous changes in the drainage system, some temporary and some permanent.

Deposits of windblown silt, called loess, which are the surface materials in most of Illinois, also are the result of glaciation. The silt was blown from floodplains of the valley trains. Most loess deposition occurred in the fall and winter seasons, when colder conditions caused meltwater floods to recede, exposing the surfaces of the valley trains and permitting them to dry out. During Pleistocene time, as now, the prevailing winds were westerly, and, as a result, the loess deposits are thickest on the east sides of the source valleys. The loess thins rapidly away from the valleys. Loess in the La Salle area probably does not exceed 3 feet in thickness.

Depositional History of the Pennsylvanian Rocks

Pennsylvanian strata form the surficial bedrock in the western part of the field trip area (fig. 2). These rocks belong to the Spoon, Carbondale, Modesto, and Bond Formations. At one time these formations completely covered the field trip area, but they have been removed by post-Pennsylvanian erosion.

At the close of the Mississippian Period, about 310 million years ago, the Mississippian sea withdrew from the midcontinent region. A long interval of erosion took place early in Pennsylvanian time. This erosion removed hundreds of feet of the pre-Pennsylvanian strata, completely strippint them away and cutting into older rocks in large areas of the Midwest. An ancient river system cut deep channels into the bedrock surface. Erosion was interrupted by the invasion of the early Pennsylvanian sea.

Depositional conditions in the Illinois Basin during the Pennsylvanian Period were similar to those that existed during late Mississippian time. The Pennsylvanian river system flowed southwestward across a swampy lowland, carrying mud and sand from northern highlands. A great delta was built out into the shallow sea (fig. 6). The lowland stood only a few feet above sea level, so that only slight changes in relative sea level caused great shifts in the position of the shoreline.

Throughout Pennsylvanian time the Illinois Basin continued to subside. The delta front continually shifted northward and southward due to worldwide sea level changes, intermittent subsidence of the basin, and variations in the amounts of sediment carried seaward from the land. The areas of land and sea continually changed as the shoreline shifted northward and southward. These alternations between marine and nonmarine conditions were more drastic and frequent than those during pre-Pennsylvanian time, and produced striking lithologic variations in the Pennsylvanian rocks.

Conditions at various places on the shallow sea floor favored the deposition of sandstone, limestone, or shale. Sandstone was deposited near the mouths of distributary channels. These sands were reworked by waves and spread as thin sheets near the shore. The shales were deposited in quiet water areas--in delta bays between distributaries, in lagoons behind barrier bars, and in deeper water beyond the nearshore zone of sand deposition. Limestone, which formed by chemical precipitation from the sea and the accumulation of limy shells of marine plants and animals, was usually deposited farther from shore than the sandstone and shale, but some limestone was formed in nearshore areas where little sand and mud were being deposited. The areas of sandstone, shale, and limestone deposition continually changed as the position of the shoreline changed and as the delta distributaries extended seaward or shifted their positions laterally along the shore.

Nonmarine sandstones, shales, and limestones were deposited on the deltaic lowland bordering the sea. The nonmarine sandstones were deposited in distributary channels, in river channels, and on the broad floodplains of the rivers. Some sand bodies, 100 or more feet thick, cut through many of the underlying rock units. The shales were deposited mainly on floodplains. Fresh-water limestones and some shales were deposited locally in fresh-water lakes and swamps. The coals were formed by the accumulation of plant material, usually where it grew, beneath the quiet waters of

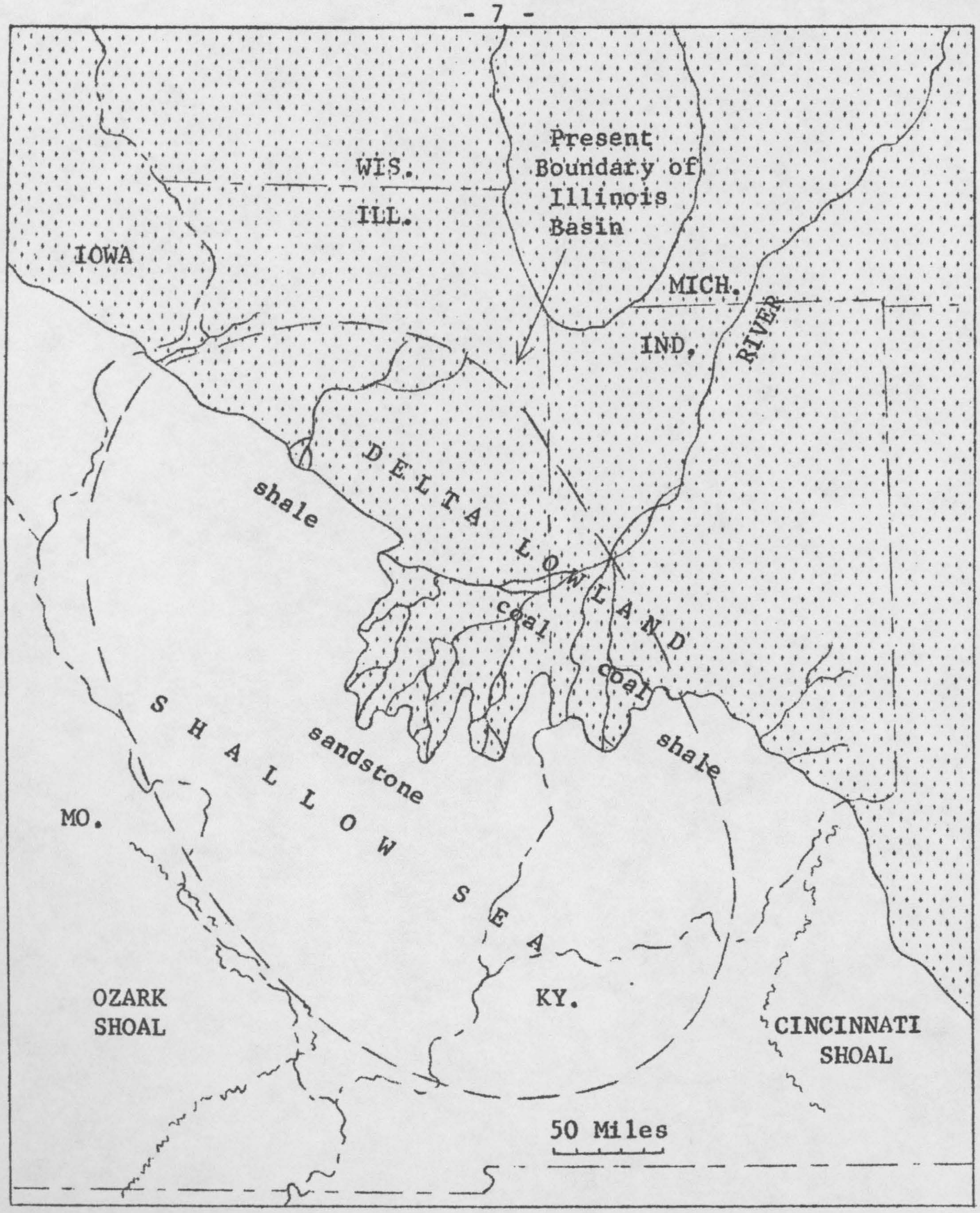


Fig. 6 - Paleogeography of Illinois-Indiana region during Pennsylvanian time. The diagram shows the Pennsylvanian river delta and the position of the shoreline and the sea at an instant of time during the Pennsylvanian Period.

extensive swamps that prevailed for long intervals on the emergent delta lowland. Lush forest vegetation, which thrived in the warm, moist Pennsylvanian climate, covered the region. The origin of the underclays beneath the coals is not exactly known, but they were probably deposited in the swamps as slackwater muds before and during the formation of the coals. The formation of coal marked the end of the nonmarine portion of the depositional cycle. Resubmergence of the borderlands by the sea interrupted nonmarine deposition, and marine sediments were then laid down over the coal.

Pennsylvanian Cyclothems

Because of the extremely variable environmental conditions under which they formed, the Pennsylvanian strata exhibit extraordinary variations in thickness and composition, both laterally and vertically. Individual sedimentary units are often only a few inches thick and rarely exceed 30 feet thick. Sandstones, shales, limestones, and coals grade laterally into one another. However, a few of the coals and several of the limestones can be traced in the subsurface over large areas of the Midwest.

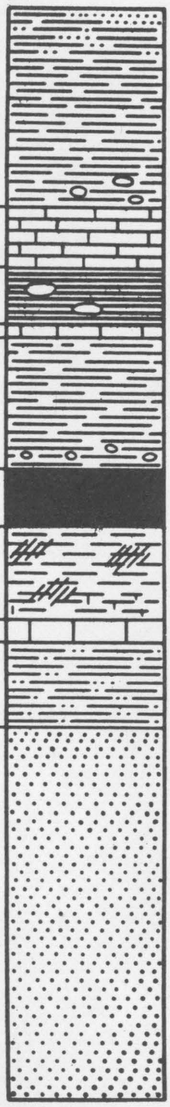
The rapid and frequent changes in depositional environments during Pennsylvanian time produced regular or cyclical alternations of sandstone, shale, limestone, and coal in response to the shifting front of the Pennsylvanian delta. Each series of alternations, called a cyclothem, consists of several marine and nonmarine rock units that record a complete cycle of marine invasion and retreat. Geologists have determined, after extensive studies of the Pennsylvanian strata in the Midwest, that an ideally complete cyclothem consists of 10 sedimentary units. The chart on the next page shows the arrangement. Approximately 50 cyclothems have been described in the Illinois Basin, but only a few contain all 10 units. Usually one or more are missing because conditions of deposition were more variable than indicated by the ideal cyclothem. However, the order of units in every cyclothem is almost always the same. A typical cyclothem includes a basal sandstone overlain by an underclay, coal, black sheety shale, marine limestone, and gray marine shale. In general, the sandstone-underclay-coal portion (the lower 5 units) of each cyclothem is nonmarine and was deposited on the coastal lowlands from which the sea had withdrawn. However, some of the sandstones are entirely or partially marine. The units above the coal are marine sediments and were deposited when the sea advanced over the delta lowland.

Origin of Coal

It is generally accepted that the Pennsylvanian coals originated by the accumulation of vegetable matter, usually in place, beneath the waters of extensive, shallow, fresh to brackish swamps. They represent the last-formed deposits of the nonmarine portions of the cyclothems. The swamps occupied vast areas of the deltaic coastal lowland, which bordered the shallow Pennsylvanian sea. A luxuriant growth of forest plants, many quite different from the plants of today, flourished in the warm Pennsylvanian climate. Today's common deciduous trees were not present, and the flowering plants had not yet evolved. Instead, the jungle-like forests were dominated by giant ancestors of present-day club mosses, horsetails, ferns, conifers, and cycads. The undergrowth also was well developed, consisting of many ferns, fernlike plants, and small club mosses. Most of the plant fossils found in the coals and associated sedimentary rocks show no annual growth rings, suggesting rapid growth rates and lack of seasonal variations in the climate. Many of the Pennsylvanian plants, such as the seed ferns, eventually became extinct.

Plant debris from the rapidly growing swamp forests--leaves, twigs, branches, and logs--accumulated as thick mats of peat on the floors of the swamps. Normally, vegetable matter rapidly decays by oxidation, forming water, nitrogen, and carbon dioxide. However, the cover of swamp waters, which were probably stagnant and low in oxygen, prevented the complete oxidation and decay of the peat deposits.

The periodic invasions of the Pennsylvanian sea across the coastal swamps killed the Pennsylvanian forests and initiated marine conditions of deposition. The peat deposits were buried by marine sediments. Following burial, the peat deposits were gradually transformed into coal by slow chemical and physical changes in which pressure (compaction by the enormous weight of overlying sedimentary layers), heat (also due to deep burial), and time were the most important factors. Water and volatile substances (nitrogen, hydrogen, and oxygen) were slowly driven off during the coalification process, and the peat deposits were changed into coal.



10 Shale, gray, sandy at top; contains marine fossils and ironstone concretions, especially in lower part.

9 Limestone; contains marine fossils.

8 Shale, black, hard, laminated; contains large spheroidal concretions and marine fossils.

7 Limestone; contains marine fossils.

6 Shale, gray; pyritic nodules and ironstone concretions common at base; plant fossils locally common at base; marine fossils rare.

5 Coal; locally contains clay or shale partings.

4 Underclay, mostly medium to light gray except dark gray at top; upper part noncalcareous, lower part calcareous.

3 Limestone, argillaceous; occurs in nodules or discontinuous beds; usually nonfossiliferous.

2 Shale, gray, sandy.

1 Sandstone, fine-grained, micaceous, and siltstone, argillaceous; variable from massive to thin-bedded; usually with an uneven lower surface.

AN IDEALLY COMPLETE CYCLOTHEM

(Reprinted from Fig. 42, Bulletin No. 66, Geology and Mineral Resources of the Marseilles, Ottawa, and Streator Quadrangles, by H. B. Willman and J. Norman Payne)

(28197–20M–6/66)

Coals have been classified by ranks that depend on the degree of coalification. The commonly recognized coals, in order of increasing rank, are (1) brown coal or lignite, (2) sub-bituminous, (3) bituminous, (4) semibituminous, (5) semianthracite and (6) anthracite. Each increase in rank is characterized by larger amounts of fixed carbon and lesser amounts of oxygen and other volatiles. Hardness of coal also increases with increasing rank. All Illinois coals are classified as bituminous.

Underclays occur beneath most of the coals in Illinois. Because underclays are generally unstratified (unlayered), are leached to a bleached appearance, and generally contain plant roots, many geologists consider that they represent the ancient soils on which the coal-forming plants grew.

The exact origin of the carbonaceous black shales that occur above many coals is uncertain. The black shales probably are deposits formed under restricted marine (lagoonal) conditions during the initial part of the invasion cycle, when the region was partially closed off from the open sea. In any case, they were deposited in quiet-water areas where very fine, iron-rich muds and finely divided plant debris were washed in from the land. The high organic content of the black shales is also in part due to the carbonaceous remains of plants and animals that lived in the lagoons. The fossil remains of animals in the black shales are sometimes depauperate (dwarf) because they were stunted by toxic conditions in the sulfide-rich waters of the lagoons. The phosphatic siderite nodules that occur in the black shales were formed by chemical precipitation of calcium carbonate, iron carbonate (siderite), and phosphate from the brackish lagoonal waters. These features suggest slow rates of shale deposition.

Mineral Resources of the La Salle Area

The first coal found in Illinois was discovered near Ottawa in the banks of the Illinois River by early French explorers in the 17th century. Since then La Salle County has become an important producer of minerals. At the present time the following mineral commodities (in order of decreasing value) are being exploited in La Salle County: silica sand, cement, clay products, gravel, common sand, and stone. The value of minerals produced in the county during 1969 was $36.1 million, placing it fourth among the state's 102 counties. La Salle County ranked first in silica sand and cement production, and first in the manufacture of clay products in 1969. Although there has been no reported production in the county for a number of years, a total of more than 65.5 million tons of coal has been produced here since 1882.

ITINERARY

0.0	0.0	Assemble in parking lot on east side of Chartres Street, heading west. Leave parking lot and turn left (south) on Chartres Street.
0.2	0.2	STOP. Intersection with 3rd Street. Turn right (west) on 3rd Street (U.S. Route 6).
0.1	0.3	Enter Peru. Continue ahead on Route 6.
0.7	1.0	Intersection with U.S. Route 51. Continue ahead on Route 6.
0.5	1.5	STOP LIGHT. Intersection of Peoria Street and 4th Street (Route 6). Continue ahead on Route 6.
0.8	2.3	Leave Peru.

0.5 2.8 Note the even topography of the Arlington till plain to the right (north).

1.1 3.9 Divided 4-lane pavement begins.

0.15 4.05 CAUTION. Dangerous intersection. Continue ahead on Route 6.

0.15 4.2 The highway is incised into an outwash delta that was built into ancient Lake Illinois between 15,000 and 13,500 years ago. The delta was deposited by meltwater flowing from the Arlington ice front. Sand and gravel has been produced from the abandoned pits on both sides of the highway.

0.2 4.4 Burlington Northern Railroad overpass.

0.15 4.55 Cross Spring Creek.

0.4 4.95 CAUTION. End of divided 4-lane pavement

0.2 5.15 Prepare to turn left.

0.1 5.25 CAUTION. Junction U. S. Route 6 and Illinois Route 89 south. Turn left on Spaulding Street and head south on Route 89.

0.2 5.45 4-WAY STOP. Intersection with St. Paul Street. Continue ahead on Route 89.

0.25 5.7 Prepare to turn right.

0.1 5.8 Turn right on Illinois Street just before viaduct and immediately turn left downhill toward railroad tracks. Stop at bottom of hill.

0.05 5.85 Stop 1. Pennsylvanian Cramer Limestone exposed along north side of Rock Island Railroad cut. Walk east under viaduct to exposure (NW¼ NW¼ NW¼, Sec. 2, T. 15 N., R. 11 E., Bureau County; La Salle 15' quadrangle).

The Cramer Limestone is a member of the upper Pennsylvanian Modesto Formation. The limestone is nodular, fossiliferous, and six to eight feet thick. It is lenticular and appears to have been formed in a warm, shallow sea in which the bottom was considerably agitated by wave action. Elsewhere, the limestone grades laterally into nodular shales that bordered the basin of deposition. Fossils include crinoid fragments and brachiopods.

Leave Stop 1 and retrace itinerary uphill and right to Spaulding Street.

0.05 5.9 STOP. Turn right (south) on Spaulding Street (Route 89).

0.3 6.2 Illinois River Bridge. CAUTION. Prepare to turn right beyond bridge.

0.45 6.65 Turn right at Cargill elevator entrance and stop.

Stop 2. Slump structures along south valley wall of Illinois River (NE¼ NW¼ NW¼ NW¼, Sec. 26, T. 33 N., R. 1 W., Putnam County; La Salle 15' quadrangle). (NOTE: Mileage figures are given only to entrances for many stops in this itinerary.)

This location affords to the south a view of a large slump developed on the slope above the house near the base of the hill. The upper part of the bluff shows a bare scarp (cliff) several feet high that exposes glacial till and buried silt. Below it are several small terraces, partly grassed over, that have developed as a result of successive slumping of Pleistocene and Pennsylvanian strata. A close-up examination of this property shows that some of the material periodically flows doward and outward, encroaching on the back yard.

Bedrock in this area consists primarily of weak shales interspersed with thin, jointed limestones of the Modesto and Bond Formations. When wet, the shales fail and cause the overlying materials to become unstable. These materials include glacial deposits and limestones that are highly jointed into rather small rectangular blocks. Water percolating downward through the glacial deposits moves laterally when it reaches the relatively impervious underlying shale, thus producing a line of springs or seeps where the shale intersects the wall of a valley. This condition keeps the glacial debris saturated, which contributes weight to the slope, causing the underlying materials to fail.

Here the Illinois Valley is about one mile wide with valley walls that rise fairly abruptly to heights of 125 to 150 feet above the bottoms. Cutting of roads and building sites into the lower parts of these poorly drained slopes has caused slumping of the higher portions, especially during and immediately after periods of excessive precipitation.

Although foliage now obscures many slump features, examples such as slides, small terraces, and trees with trunks standing at various angles, can be seen near the base of the bluff.

Leave Stop 2 and return to Route 89. STOP. Turn right (south).

0.2	6.85	Prepare to turn left.
0.1	6.95	CAUTION. Turn left, cross bridge, and head east on gravel road.
0.3	7.25	Abandoned gravel pit on right.
1.45	8.7	Cross drainage ditch. Exposure of limestone overlying shale to right on west side of ditch. Note how broken this limestone is. It would not help to provide stable slopes.
0.15	8.85	Cross 3rd Principal Meridian. This is a north-south reference line from which well over half of the state was surveyed by the "township and range system."
1.55	10.4	T-road from right. Continue ahead and bear left.
0.2	10.6	Cross Cedar Creek and bear left.
0.1	10.7	T-road from east. DANGEROUS INTERSECTION. Turn right onto blacktop road and head uphill.
0.1	10.8	Pennsylvanian shale and limestone exposed on the right. The road is in poor condition as a result of slumping.
0.5	11.3	Golf course clubhouse on left. Continue ahead.

0.2 11.5 Turn left at Lynwood subdivision sign.

0.2 11.7 Descend hill. USE EXTREME CAUTION. The road has slumped away in several places.

0.25 11.95 On the left, braced logs have been placed against part of the bank in an attempt to keep the upper sod layers in place. Slightly downhill, on the left, Pennsylvanian shale and limestone are exposed.

0.05 12.0 Stop 3. Slump features developed on subdivision slopes (S½ NE¼ NW¼, Sec. 28, T. 33 N., R. 1 E., La Salle County; La Salle 15' quadrangle).

To the right of the drive, the slope is hummocky as a result of slumping that formed several small step-like terracettes. The scarps (or "risers") are mantled with slumped rubble and vegetation. Notice that tree trunks are standing at various angles because of the downhill slumping and sliding. Some are tilted back toward the slope, indicating that there has been some rotation of the terracettes as they slumped downward and outward.

On the northeast side of the tributary valley to the east, a home site was abandoned after the foundation had been laid because large cracks appeared in the soil close to the structure. The cracks indicated that the slope around the site was unstable. A building would create a further load that most likely would cause additional slumping and subsequent structural damage.

In some localities, lawn watering and septic tank effluent also inject water into such unstable materials, large amounts of which are retained. Because of some degree of rotational slump, the top surfaces of terraces frequently have water ponded along their back edges. The presence of so much water keeps the underlying shales wet and permits gradual creep of the areas even when rainfall is not heavy. During periods of high rainfall, the rubble and lower parts of the terrace also become saturated and mud flowage occurs until more stable conditions are achieved. When the mud flows fill ditches and cover roads, they must be removed, which again produces unstable conditions and leads to another cycle of slumping.

Sliding and slumping of earth materials will recur naturally. Improper construction procedures also will upset the critical balance in a particular area, causing an acceleration of sliding that may result in extensive damage to property. To stabilize slopes that are affected by building, ditches and storm water conduits may be installed to provide rapid drainage to keep the slopes dry. Unstable bluffs may be rebenched to create slopes with a lower angle of repose to provide more stability. These newer benches then are compacted to make them less permeable to water.

Leave Stop 3. Continue ahead.

0.4 12.4 Thick, unconsolidated outwash gravels mantling top of slope underlain by shale.

0.4 12.8 STOP. Intersection with gravel and blacktop road. Turn left.

1.2 14.0 Intersection with Route 51. Stop light. USE EXTREME CAUTION. Continue straight ahead toward Oglesby.

0.2 14.2 Crossroads. Sign points to the left to Illinois Valley Community College. Turn left (north) on blacktop.

0.8 15.0 CAUTION. Sharp curves to the right going around college.

0.35 15.35 Old coal mine spoils on left.

0.15 15.5 Y-intersection. Bear right.

0.15 15.65 Y-intersection from left. Continue ahead toward right.

0.6 16.25 Railroad overpass. Continue ahead.

0.2 16.45 Enter Jonesville. Note red-topped conical mound to left. This mound is composed of waste rock taken from the La Salle County Carbon Coal Company, Jones #1 Mine. This underground shaft mine was opened in 1886 and abandoned in 1928. Three feet of No. 7 Coal was encountered at a depth of 217 feet; 4 feet of No. 5 Coal at 276 feet; and 3½ feet of No. 2 Coal at about 436 feet.

Shaft mines that utilized the longwall method of mining produced much of the coal mined in La Salle County. In longwall mining, the hoist (main shaft), air shaft, and usually four entries or haulageways occupied a large central coal pillar that supported the surface works for the mine. The working-face, or longwall, was advanced outward away from this central column in such a way that essentially all of the coal was mined out. The coal was undercut with hand picks and then pulled down from the roof with iron wedges. Much of the waste clay and shale produced from undercutting the coal was thrown back into the mined-out areas to offer some support when the roof rock broke and caved in. Timbering and cribbing were installed to protect the haulageways and keep them open when the roof caved in. Abandoned longwall mines are responsible for the conspicuous high, conical spoil piles scattered throughout this part of Illinois. Waste rock from the mine and from cleaning the coal was discarded onto these piles, where it frequently smoldered or burned, accounting for the rather distinctive red coloring on some of them.

0.05 16.5 Y-intersection with Route 71 North. Bear left onto 71.

0.25 16.75 Bridge across Vermilion River.

0.15 16.9 Roadcut through La Salle Limestone.

0.25 17.15 Abandoned cement quarry on right.

0.7 17.85 The three stacks in the distance belong to cement plants. The two on the right belong to the Marquette Cement Company's operation. The one to the left is at an abandoned plant.

0.9 18.75 T-road from right. Oglesby Road. Continue straight ahead.

1.1 19.85 Approaching junction with 178. SLOW, prepare to turn right. Notice the gravelly and sandy outwash on the roadcut on either side.

0.2 20.05 Turn right (south) on 178.

0.8 20.85 SLOW. Prepare to turn right.

0.2 21.05 Turn right toward Matthiessen State Park.

0.9 21.95 Matthiessen State Park parking area. Turn left and park.

Stop 4. West limb of La Salle Anticlinal Belt exposing Ordovician St. Peter Sandstone and Platteville Dolomite Group (SW¼ Sec. 29, T. 33 N., R. 2 E., La Salle County; La Salle 15' quadrangle).

The La Salle Anticlinal Belt, a broad upfold or arch of the bedrock, is the largest structural feature in Illinois. Its long axis extends in a southeasterly direction from La Salle County into southwestern Indiana (fig. 4). The anticline is asymmetrical, with the west limb dipping or inclined more steeply than the east (fig. 7). The Platteville Dolomite exposed here near the crest of the fold occurs approximately 1,800 feet below the surface only a few miles to the west.

At this locality the Platteville Dolomite Group rests on the St. Peter Sandstone. Elsewhere, the Glenwood Formation, composed of sandy dolomite, sandstone, and shale, occurs between the St. Peter and the Platteville strata. Here the Glenwood is not readily discernible from the St. Peter, indicating that it either was eroded from the area before the Platteville was deposited or else may be transitional with the upper portion of the St. Peter.

Pennsylvanian strata are well exposed in the Vermilion River bank. These rocks dip (tilt) less than the underlying Ordovician strata, indicating that the older rocks were inclined during uplift of the La Salle Anticline before the Pennsylvanian strata were deposited. The angular relation between these two systems of strata indicates an erosion surface known as an angular unconformity.

The anticline is not a single, simple fold, but appears to be composed of a broad belt (up to 25 miles wide) of many minor folds (anticlines and synclines) superimposed on a larger, major anticlinal structure. This is particularly true farther south in the Illinois Basin. Deformation appears to have taken place several times along the anticline, beginning perhaps before the deposition of the St. Peter Sandstone. However, the main uplift probably occurred in late Mississippian and/or early Pennsylvanian time, with lesser folding during and after the Pennsylvanian Period. The structure is also well exposed at Split Rock across the Illinois River and northward at Stop 9. A line connecting these localities shows the approximate trend of the crest of the structure.

The Ordovician Platteville Group is divided into five formations. Although the two oldest of these, the Pecatonica (the oldest) and the Mifflin, are present, it has been difficult to separate them with any degree of certainty on the basis of well cuttings. Therefore, the Platteville is treated as a single unit here.

The Platteville consists of brown and grayish brown, compact, finely crystalline dolomite and brown and gray, fossiliferous, dolomitic limestone. The lower part tends to be sandy dolomite and the upper portions contain chert. Geographically, the distribution of dolomite or limestone is related to major structures. The dolomite content of the Platteville increases toward the crest of the La Salle

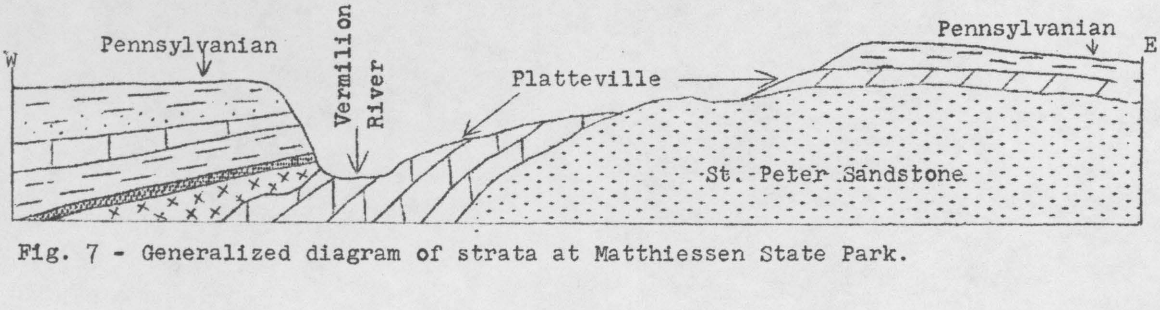


Fig. 7 - Generalized diagram of strata at Matthiessen State Park.

Anticlinal Belt and along other major structures in northern Illinois; the higher parts of the structures are almost entirely dolomite. Although the Platteville ranges in thickness from 125 to 140 feet in near-by areas, it has been thinned or removed by erosion across the top of the La Salle Anticline in northern Illinois.

Leave Stop 4.

0.1	22.05	Turn right and retrace steps to hard road.
0.8	22.85	STOP. Intersection with Route 178. Turn right (south).
2.45	25.3	Prepare to turn right just below brow of hill.
0.1	25.4	Turn right onto gravel road.
0.15	25.55	Stop 5. Ristokrat Clay Products Company clay pit. Units of the Pennsylvanian Spoon and Carbondale Formations exposed in pit highwall (NW¼ SE¼, Sec. 8, T. 32 N., R. 2 E., La Salle County; La Salle 15' quadrangle).

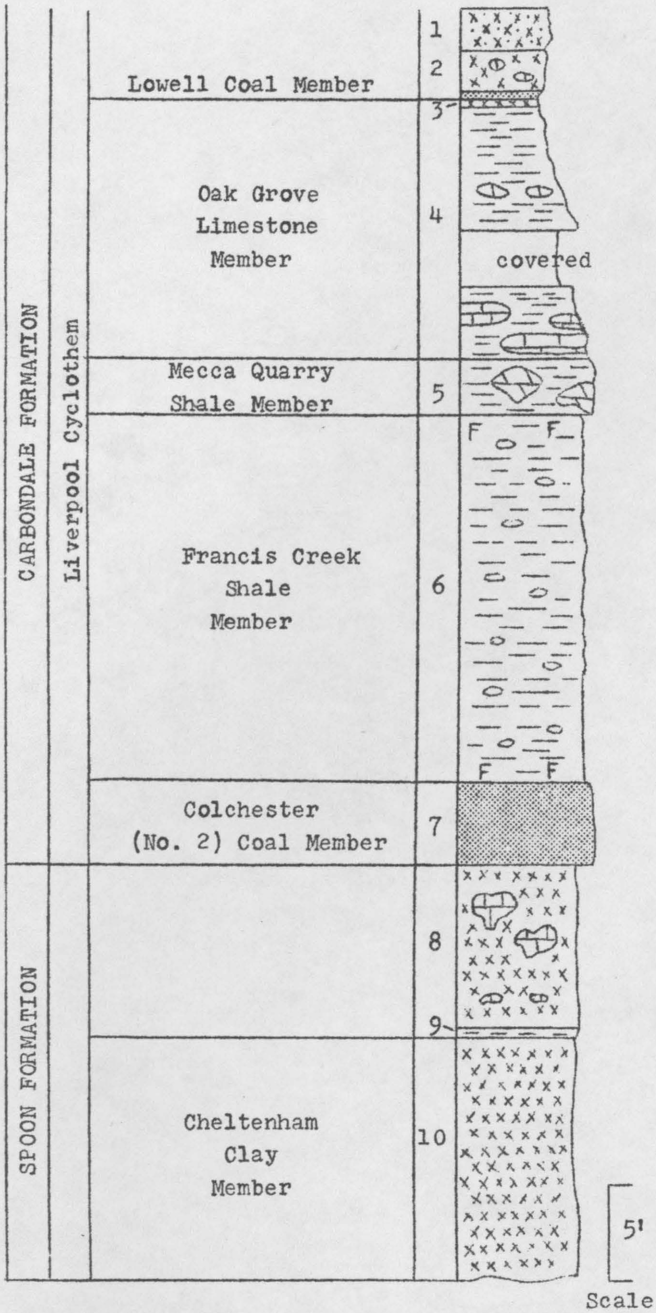
Both the refractory Cheltenham Clay Member below the Colchester (No. 2) Coal Member and the Francis Creek Shale Member overlying the coal are mined for brick making (fig. 8).

The No. 2 Coal and the underclay sequence beneath it are well exposed. The underclay contains limestone nodules up to 3 feet in diameter that have an unusual radiating structure resembling cone-in-cone. Small masses and rosettes of twinned pyrite crystals may be found in the underclay sequence. In the overlying Francis Creek Shale, a pelecypod fauna can be observed in the lowest few inches. The remaining 18 feet of this shale is light gray and uniform in texture except for a 4- to 6-inch darker gray zone at the top that contains a mixed brachiopod and pelecypod fauna.

Leave Stop 5 and return to highway.

0.15	25.7	STOP. Intersection with Route 178. USE EXTREME CAUTION upon entering highway for left turn (north).
1.45	27.15	Prepare to turn right.
0.1	27.25	Turn right (east) onto gravel road.
1.4	28.65	Hummocky knob and kettle topography, typical of end moraines, developed on Farm Ridge Moraine.
0.3	28.95	High knob (more than 700 feet above sea level) on the left.
0.55	29.5	STOP. Crossroads. Turn left (north) on blacktop road.
0.25	29.75	Stop 6. Roadcut exposure of Farm Ridge Drift on east side of road (NW cor. SE¼ SW¼, Sec. 35, T. 33 N., R. 2 E., La Salle County; Ottawa 15' quadrangle).

The top of the exposure affords a good view of the hummocky end moraine topography, especially to the west. The Farm Ridge Moraine is 1 to 2 miles wide with a crest 30 to 40 feet high, although locally it may be as much as 60 feet thick.



1. Claystone - tan with some prominent pink zones, very badly weathered.

2. Claystone - medium gray, very badly weathered; contains two zones of slightly fossiliferous, lithographic limestone nodules.

3. Claystone - yellowish brown, weathered.

4. Shale - medium gray, moderately hard, fairly well laminated although somewhat nodular; contains several discontinuous beds and large nodules (up to 15" thick) of medium gray dense limestone mainly in bottom 4', a few crinoid stem fragments noted near base, upper 4' very weathered.

5. Shale - black, sheety, hard, contains copralites, fish remains and phosphatic lenses, a zone of dark gray oval and lenticular nodules occur near base, in places unit is composed almost entirely of large limestone concretions.

6. Shale - medium light gray, smooth, soft, very uniform (quarried for brick making), contains pyritized fossil fragments (mostly pelecypods and a few well preserved plant remains) near the base, occasional siderite and pyrite nodules scattered throughout; uppermost 4 to 6" is darker gray and contains many pyritized fossil fragments (mostly pelecypods).

7. Coal - normally banded and bright.

8. Claystone (seatrock) - medium gray to medium dark gray, becomes darker in color downwards, small slip fractures common, contains a zone near the top with large (up to 3' in diameter), irregular, light gray finely crystalline limestone nodules having a radiating structure, also contains a zone 1' from the base of brownish gray, finely crystalline limestone nodules up to 4" in diameter.

9. Shale - medium dark gray to dark gray, slightly mottled with light greenish gray, poorly laminated, contains a few carbonized plant remains.

10. Claystone - light greenish gray, slip fractures abundant, poorly preserved carbonized plant material; base of claystone is unconformable with up to 10' of relief on Ordovician limestone.

Fig. 8 - Columnar section at Ristokrat Clay Pit (from ISGS Guidebook Series 8; 1970).

The ground moraine deposited behind (east) the end moraine commonly is 5 to 15 feet thick. The moraine is divided into two segments separated by the Illinois River. Total length of the moraine is about 50 miles. It terminates to the southeast against the younger Marseilles Morainic System and to the north against the Elburn Complex.

Pleistocene Series

Wisconsinan Stage

Undifferentiated

Soil, reddish brown, noncalcareous; scattered small pebbles may be a result of drag from road building; 2½ to 3 feet

Woodfordian Substage

Wedron Formation

Farm Ridge Drift

Till, light to medium brown, pebbly, with some cobbles and large number of limestone pebbles and cobbles; calcareous; contains pods of yellow-brown silt that droop over part of the exposure; base not exposed; 8+ feet

Leave Stop 6. Continue ahead.

0.75	30.5	STOP. T-road intersection. Turn right (east) on gravel road.
0.45	30.95	Turn left (north).
1.1	32.05	Y-intersection with Illinois Route 71. Bear left and STOP. Turn left (west). CAUTION: the highway for the next couple of miles is very tortuous and dangerous.
0.3	32.35	Hennepin Canyon to the right.
0.8	33.15	La Salle Canyon to the right.
0.4	33.55	Tonti Canyon to the right.
1.0	34.55	SLOW. Prepare to turn right.
0.2	34.75	Starved Rock State Park entrance. Turn right (north).
0.5	35.25	T-road from right. Continue ahead downhill. USE EXTREME CAUTION - dangerous road.
0.35	35.6	Approaching one-way drive. KEEP TO RIGHT.
0.2	35.8	Parking area entrance to right. LUNCH. Assemble to east near Starved Rock after lunch.

Stop 7. Discussion of the St. Peter Sandstone and the erosional history of the upper Illinois Valley (SW¼ NW¼ NW¼, Sec. 22, T. 33 N., R. 2 E., La Salle County; Ottawa 15' quadrangle).

St. Peter Sandstone

The St. Peter Sandstone is of special interest geologically because of its widespread distribution and its remarkably high purity. The St. Peter occurs over a vast area of the Midwest, stretching from northern Michigan to Kentucky and from Kansas to Ohio. Principal areas of exposure in Illinois are in the Dixon-Oregon area and the Ottawa-La Salle area, where the Champlainian (middle Ordovician) rocks are brought to the bedrock surface along the flanks of the Oregon Anticline, the Ashton Arch, and the La Salle Anticline. The St. Peter forms high bluffs along the Illinois River here at Starved Rock State Park, with Starved Rock itself presenting a north-facing cliff approximately 125 feet high. Outside of these areas the St. Peter has been penetrated in the subsurface by many wells. Except where it has locally been removed by erosion, the formation underlies almost the entire state.

The St. Peter Sandstone is a remarkably pure, fine-grained sandstone consisting of well rounded grains of quartz. Many of the grains exhibit a peculiar frosted or dull appearance. The sandstone also exhibits well developed, inclined laminations called <u>cross bedding</u>. At many exposures the sandstone is light gray to pure white, giving the formation a distinctive appearance, but commonly it is slightly brownish in color because of staining by iron oxide. The sandstone is typically friable and soft, exhibits a sugary texture, and is easily disaggregated in the hand. In the subsurface the St. Peter is sometimes tightly cemented by calcium carbonate, suggesting that its loose texture at the surface has been produced by the removal of the cement by weathering and by leaching by percolating ground water.

The origin of the St. Peter Sandstone has interested geologists for a long time. An early theory suggested that the sandstone was deposited on the land in a vast interior desert of drifting dune sand. Similar cross bedding, roundness, and frosting are found in sands of present-day deserts, such as the Great Sahara Desert of North Africa. The rounding and frosting is caused by the grains' striking each other as they are moved along by the wind. Today most geologists believe that the St. Peter is a marine deposit. All of the properties of the sandstone can be explained as the products of wave and current action in a shallow sea. Beds of marine limestone are present in the middle and upper parts of the formation in extreme northern and southwestern Illinois, Iowa, Arkansas, and Oklahoma. Marine fossils occur in some of the limestone beds, and, although extremely rare, in the sandstone as well. The sand was derived principally from Precambrian igneous and metamorphic rocks in south-central Canada and transported southward by stream into the middle Ordovician sea about 460 million years ago. Conditions in the sea remained very stable for a long time, and the sands were extensively reworked by waves and currents, which wore away the less resistant mineral grains and removed the muddy sediments, leaving behind the well sored, highly resistant quartz sand. As the quartz grains were moved along the sea bottom by currents and washed back and forth by waves, they gradually became rounded and frosted. Cross bedding in the St. Peter Sandstone also indicates a high-energy, agitated environment and more strongly resembles cross bedding exhibited by known marine sandstones than that found in dune sandstones. Some shifting of the St. Peter sands probably occurred in dunes along the shoreline of the St. Peter sea, similar to that occurring along present day shorelines. These dune sands were later eroded and incorporated into the marine deposits as the sea advanced toward the north.

The contact between the St. Peter Sandstone and the older sedimentary rocks upon which it rests is a major unconformity or erosion surface throughout the Midwest. After deposition of the Canadian (lower Ordovician) strata, crustal movements raised the midcontinent region above sea level, and a long interval of erosion accompanied by widespred development of solution features (karst topography) cut deeply into the underlying rocks. There is evidence that a river system drained across northern Illinois from the northeast and cut deep channels into the bedrock. In northern Illinois and southern Wisconsin the lower Ordovician strata were completely removed from the flanks of the Wisconsin Arch in many places. The erosion interval ended when the midcontinent region was lowered below sea level again.

When the middle Ordovician sea advanced over the midcontinent, the clean, well sorted St. Peter Sandstone was deposited on the erosional surface of lower Ordovician and Cambrian rocks. The sandstone is generally less than 200 feet thick, but where the sand filled ancient river channels, it is locally as much as 500 feet thick. Recently, Survey geologist T. C. Buschbach presented evidence that some of the unusual thicknesses of sandstone were the result of deposition in large sinkholes rather than in river channels. The sinkholes were formed by the solution of the lower Ordovician limestones by percolating ground water during the pre-St. Peter erosion interval.

The St. Peter Sandstone is a valuable source of silica sand. It is world famous as a glass sand, but it is also used as molding sand (foundry sand), as an abrasive, in the manufacture of silica brick, ceramic glazes, and ferro-silicon, and for a score of other uses. The oil industry uses the sand in the fracture treatment of oil-bearing formations to increase the flow of oil through the rocks. Illinois ranks first in the production of glass sand in the United States, almost all of it coming from the St. Peter Sandstone in La Salle and Ogle Counties. The production of silica sand in Illinois in 1969 totaled 4,394,950 tons, valued at $15,770,919.

History of the Illinois Valley

The Illinois Valley had its origin during the early part of the Ice Age, about 1,000,000 years ago. There is little evidence to indicate exactly what the drainage system in this region was like before that time. However, major drainage at the beginning of the Pleistocene Epoch seems to have been northward, not southward as at the present time. With the advance of the Nebraskan glacier, the first of the glacial advances, from the northwest, the northward-draining rivers were blocked by the ice. Nebraskan meltwater was forced to seek a southward escape route, and a major meltwater channel was eroded around the eastern margin of the Nebraskan glacier. This channel entered northwestern Illinois near Fulton in Whiteside County and extended southeastward to the present "Big Bed" of the Illinois Valley near Hennepin. From there it followed approximately the present course of the Illinois Valley to a junction with another meltwater valley (the Ancient Iowa River Valley) near Grafton in Calhoun County. By the end of the Nebraskan glaciation the valley had been permanently established. For most of Pleistocene time the valley was occupied by an ancestral stream called the Ancient Mississippi River. The valley was deepened and widened by the Ancient Mississippi during the Nebraskan glaciation, the Aftonian interglacial interval, and the Kansan glaciation. Evidence indicates that the valley was cut to its greatest depth by the time the Kansan glacier invaded Illinois.

The Ancient Mississippi continued to follow its course to the Big Bend, about 20 miles west of here, until the valley was overridden by the advance of the Wisconsinan glacier in the early part of the Woodfordian glaciation some 20,000 years ago. This advance, called the Shelbyville, forced the Ancient Mississippi River westward, where it cut through a bedrock divide at Cordova south of Fulton and joined the valley of the Ancient Iowa River, the course it now follows along the western side of Illinois. The valley from Fulton to the Big Bend was filled by Shelbyville drift and permanently abandoned. The upper Illinois Valley east of the

Big Bend was then cut by meltwater during the numerous advances and retreats of the Woodfordian glacier and by overflow from glacial Lake Chicago. Although the Ancient Mississippi Valley had been overridden by the advances of the Illinoian glacier and partially filled by drift, westward diversion of the river was temporary. Only relatively minor changes in the position of the valley took place. After the Illinoian glacier melted, the Ancient Mississippi River was able to return its course to the Big Bend and then southward through the present Illinois Valley.

The present deep gorge of the Illinois Valley east of the Big Bend was largely cut during two major stages of erosion, although some deepening of the valley occurred during melting of the Marseilles, Minooka, Rockdale, and Manhattan ice fronts when meltwaters flowed down the Illinois Valley. The first major stage of cutting occurred during the retreat of the Valparaiso glacier about 13,000 to 12,000 years ago when an unusually large amount of meltwater discharged down the Illinois Valley. Most of this meltwater entered the Illinois Valley from the Kankakee Valley, and this great flood has been named the Kankakee Flood (fig. 1, #11). At the height of the flood the amount of meltwater from the Valparaiso front was so great that the waters backed up into lowlands behind some of the Woodfordian end moraines and formed several large lakes (see Glacial Map of Northeastern Illinois). As the floodwaters waned, the Illinois Valley was cut down to a level of about 550 feet, the approximate level of the top of Starved Rock and Buffalo Rock, a few miles east of here.

The second major stage of downcutting took place between about 11,000 and 9,000 years ago when overflow from glacial Lake Chicago, an early stage of Lake Michigan, deepened the valley to about 490 feet. Lake Chicago was formed when meltwater became ponded between the Valparaiso Moraine and the front of the Valderan glacier, which lay in the Lake Michigan Basin to the north. This level is called the Ottawa Terrace. Since Lake Chicago time, the river has cut its present inner valley about 30 feet below the level of the Ottawa Terrace.

Leave Stop 7. Turn right at exit from parking area and follow blacktop road around to the right (west). St. Peter Sandstone crops out along the west side of the road continuously from here to Illinois Route 178.

0.85	36.65	STOP. Intersection with Route 178. Turn right (north).
0.3	36.95	Cross Illinois River bridge.
0.1	37.05	View of Shakopee Dolomite in quarry to left. Prepare to turn left.
0.3	37.35	Crossroad. Turn left (west).
0.5	37.85	Utica Stone Company quarry entrance to right.

Stop 8. Shakopee Dolomite exposed in quarry (S½ SW¼ NE¼ and SW¼ SE¼ NE¼, Sec. 17, T. 33 N., R. 2 E., La Salle County; La Salle 15' quadrangle).

The Shakopee Dolomite Formation in this quarry is the oldest to be studied on this field trip. It is the uppermost, or youngest, member of the Ordovician Prairie du Chien Group. In the field trip area, the formation crops out along the Illinois and Little Vermilion Rivers and their tributaries north and east of La Salle. Here the dolomite occurs beneath a thin cover of gravel and sand.

At this quarry, core holes through the Shakopee indicate that it has a maximum thickness of 124 feet, although in nearby areas it is approximately 200 feet thick. This exposure is almost on the crest of the La Salle Anticline.

The Shakopee Formation is primarily composed of dolomite, but as much as 25 percent of it is sandstone and shale that locally occur in lenses or thin beds. The dolomite is tan to light brown or gray, finely to medium crystalline, and generally sandy. A few cephalopods and gastropods and locally abundant algal stromatolites are present. The thin quartz sandstone at the top of the quarry may be the St. Peter Sandstone.

Origin of the Dolomites

Most geologists believe that dolomites were originally deposited as limestone by the chemical precipitation of calcium carbonate from sea water and by the accumulation of the calcareous remains of marine plants and animals. At some time after their deposition the limestones were changed to dolomites.

During dolomitization, magnesium ions replace calcium ions in the atomic structure of the mineral calcite ($CaCO_3$). Based upon the degree of dolomitization, a carbonate rock is classified as limestone (0-10% dolomite), dolomitic limestone (10-50% dolomite), calcitic dolomite (50-90% dolomite), or dolomite (90-100% dolomite). In pure dolomite the calcium-magnesium ratio is about one to one. Small amounts of ferrous iron usually replace some of the magnesium in dolomite, resulting in the characteristic light brown color of most weathered dolomite formations. Recrystallization also takes place during dolomitization, in many cases producing the sucrosic (sugary) texture that is also characteristic of many dolomites. Because of this recrystallization, primary sedimentary structures, such as current features and fossil remains, are destroyed or, at best, are poorly preserved.

Geologists do not agree on the origin of the dolomites. Some geologists believe that dolomitization takes place soon after deposition, when the unconsolidated, limy sediments are still in contact with the sea water. Magnesium in the sea water is exchanged for calcium in the sediments by a reaction with the sea water that bathes the upper part of the sediments. Other geologists believe that dolomitization takes place after the limy sediments have been consolidated to limestone, by a reaction with magnesium-rich formation water (connate water) that was trapped in the limy sediments or in associated sandstones and shales during deposition. Another idea is that dolomitization is accomplished by ground water that becomes charged with magnesium from the zone of weathering at the earth's surface. The magnesium-rich ground water percolates through the pores and cracks (joints) in the limestones altering them to dolomite. A few geologists believe that dolomite is precipitated directly from sea water under special environmental conditions and that many dolomites are primary in origin, rather than secondary alteration products of limestone. However, the special conditions required for primary precipitation of dolomite generally are not found in present-day regions where limestone is being deposited in the seas, and nowhere in the present seas have geologists definitely established that primary dolomite is being formed. Space does not permit an evaluation of the various theories that have been proposed to explain dolomitization. Suffice it to say that the problem is not solved.

Leave Stop 8. Retrace itinerary to Route 178.

0.5 38.35 STOP. Intersection with Route 178. CAUTION. Turn left (north).

0.45 38.8 Enter village of Utica.

A silica open-pit mine can be seen along the bluff northeast of Utica. The Bellrose Silica Company operates a mine and modern preparation plant producing washed silica sand for a variety of industrial purposes.

0.15 38.95 Cross abandoned Illinois and Michigan Canal.

The feasibility of digging a canal to connect Lake Michigan and the Illinois River, via the Des Plaines and Chicago Rivers, was recognized early during the settlement of Illinois. As far back as 1673 Joliet and Marquette had noted the possibility.

In 1829 Congress authorized the State to build a canal to join Lake Michigan and the Illinois River, at an estimated cost of $4,000,000. Work began in 1836, but the 1837 panic affected the project and construction was stopped in 1839. Work was resumed, but in 1843, after almost $5,000,000 had been spent, the original lake-level canal program was abandoned in favor of a cheaper, shallow-cut canal with locks. It was finally completed in 1848 and extended 95 miles from La Salle to a point in Chicago just north of present-day Interstate 55 and Ashland Avenue.

Illinois mineral producers were among the important users of the canal. Coal could easily be shipped to eastern markets, and stone, sand, and gravel were sent from place to place along the waterway. Lumber, salt, agricultural implements, and steel tracks for building railroads were imported into Illinois via the canal.

The canal was instrumental in turning Chicago into a major transportation hub by linking it to the industrial east. After the railroads had been built, however, their competition led to a slump in the use of the canal. Additional competition from the larger Chicago Sanitary and Ship Canal in the 1890s finally put the Illinois and Michigan Canal out of business. Today, efforts are being made to preserve the canal and adjacent lands as recreational areas.

0.05 39.0 STOP. Turn left (west) on Route 178.

0.1 39.1 Turn right (north) on Route 178. CAUTION. Main line of Chicago, Rock Island and Pacific Railroad - 4 tracks.

0.3 39.4 T-road from left. Turn left (west) on blacktop and cross narrow bridge.

1.35 40.75 STOP. Intersection with U. S. Route 6. Turn left (west).

0.45 41.2 St. Peter Sandstone exposed in roadcut.

0.2 41.4 Prepare to turn right.

0.15 41.55 Turn right and follow a very rough older portion of the highway part way around the curve.

0.1 41.65 Continue straight ahead (west) on the blacktop.

0.05 41.7 Crossroad. Continue ahead.

1.0 42.7 STOP. T-road intersection. Turn right (north).

0.7	43.4	Prepare to turn left.
0.2	43.6	Turn left (west) on gravel road just before crossing I-80 overpass.
0.8	44.4	Sharp turn to left (south). CAUTION. Descend hill.
0.2	44.6	Cross Little Vermilion River bridge.
0.05	44.65	Stop 9. St. Peter Sandstone and Pennsylvanian Spoon and Carbondale Formations exposed along east bank of river (NE¼ NW¼ NW¼, Sec. 2, T. 33 N., R. 1 E., and S½ SW¼ SW¼, Sec. 35, T. 34 N., R. 1 E., La Salle County; La Salle 15' quadrangle).

To the north of the bridge, the St. Peter Sandstone has an apparent dip of approximately 23° west along the lower portion of the bank. An angular unconformity exists between it and the overlying 1 foot of Pennsylvanian sandstone. The basal unit of the Pennsylvanian, which has an apparent dip of about 11° west, occurs several feet below the Colchester (No. 2) Coal. The coal has been mined along the bank of the river. This exposure in conjunction with Stop 4 illustrates the southward plunge of the La Salle Anticline along its axis. Here the Pennsylvanian rests directly on the St. Peter, whereas at Stop 4 (Matthiessen State Park) the Pennsylvanian rests on the Platteville Dolomite Group, which overlies the St. Peter.

Following is a composite section of outcrops along Little Vermilion River north and south of bridge and in roadcut east of bridge:

	Thickness (Ft.)	Thickness (In.)
Pennsylvanian System		
Summum Cyclothem		
Pleasantview Sandstone Member		
Siltstone, sandy, calcareous, light gray, slightly micaceous, thin bedded	3	
Lowell Cyclothem		
Shale, gray, soft, sandy at top	2	
Limestone, dark gray, weathering rusty, dense		0-4
Shale, gray, soft, thin bedded		4
Shale, very dark gray, soft	5	
Shale, light gray, soft, thin bedded; contains discoid rusty-weathering gray limestone concretions; fossiliferous, with Mesolobus mesolobus, Ambocoelia planoconvexa, Marginifera muricatina abundant	9	
Limestone, dark gray, pyritic, fossiliferous; weathers brown		0-2
Shale, black, soft, thin bedded; white shells of Chonetes flemingi, Mesolobus mesolobus, Linoproductus pratteni-anus, Marginifera muricatina, Ambocoelia planoconvexa, Juresania sp. abundant in upper part and Aviculopecten rectilaterarius abundant in lower part	2	
Siltstone, light chocolate brown, micaceous; fossils, poorly preserved	2/3-3	
Tonica Cyclothem		
Shale, black or dark gray, soft	0-1	
Limestone, very dark gray, pyritic, fossiliferous, locally crowded with pelecypods; weathers rusty		2-10

	Thickness (Ft.)	Thickness (In.)
Shale, black, soft		0-10
Shale, sandy, gray; contains large septarian limestone concretions, mostly in upper 3 feet	7	
Shale, black, hard, sheety; base concealed	1	

Leave Stop 9. Turn around and retrace itinerary to the east.

0.5	44.7	Cross Little Vermilion River bridge.
1.0	45.7	STOP. T-road intersection. Turn right (south) on blacktop road.
1.95	47.65	STOP. Intersection with Route 6. Turn right (west).
0.15	47.8	At right, excellent view of abandoned quarry developed in Pennsylvanian La Salle Limestone Member. Note strata to west tilted at about 11^{o}.
0.15	47.95	Prepare to turn right.
0.2	48.15	Turn right at entrance to Oakwood Cemetery and ascend hill.
0.25	48.4	Crossroad. Turn right (east).
0.1	48.5	Entrance to Mertel Gravel Company gravel pit.

Stop 10. Gravel pit in Lake Illinois delta. (SE¼ NE¼ SW¼, Sec. 11, T. 33 N., R. 1 E., La Salle County; La Salle 15' quadrangle.)

The thick sand and gravel deposit in this abandoned pit is an outwash delta that was built into Lake Illinois, a great, elongate meltwater lake that occupied the Illinois Bedrock Valley throughout most of the Woodfordian Substage. The lake was formed when the Bloomington Moraine was deposited across the Illinois Valley at Peoria. Meltwater backed up behind the morainal dam, and the lake, when the valley was not occupied by the Woodfordian glaciers, extended along the entire Illinois Valley. The lake persisted for about 1,500 years, from the retreat of the Bloomington front about 15,000 years ago until the retreat of the Marseilles front about 13,500 years ago, when the dam was breached and the lake finally drained.

Until the advance of the Cropsey glacier, Lake Illinois had extended up the Ticona Valley, a narrow glacially buried bedrock valley that lies about 6 miles south and parallel to the present Illinois River, after each retreat of the Woodfordian glacier. The present Illinois Valley from Depue eastward did not exist. The Ticona Valley had been nearly filled by drift of the Shelbyville, Bloomington, and Normal glaciations, and during the Cropsey glaciation it was completely buried by drift and was abandoned. The present upper Illinois Valley also originated during the Cropsey glaciation. However, why the valley was developed along its present course where it had to cross bedrock divides, rather than being re-eroded along the softer glacial deposits of the Ticona Valley, is a problem that has not been solved. Nevertheless, when the Cropsey glacier had retreated, a shallow depression existed in the till plain along the course of the present valley. This depression may have been formed by subglacial drainage of the Cropsey glacier. As the Cropsey ice front retreated, the waters of Lake Illinois extended into this depression.

During retreat of the Bloomington, Normal, Cropsey, Farm Ridge, and Marseilles ice fronts, a series of deltas was built into Lake Illinois. These deltas are preserved from the vicinity of Bureau eastward for several miles past Marseilles. The tops of the deltas are at an elevation of 600 feet above sea level, indicating that this was the approximate elevation of the surface of Lake Illinois. If any deltas were deposited in the lake south of Bureau they were later destroyed by erosion during widening of the valley.

The delta here at Stop 10 was deposited by meltwater that flowed from the Farm Ridge ice front. Tilted beds are called foreset beds, and they show the angle at which the gravel beds were deposited as the delta extended out into the lake. Although the gravel is badly slumped in this exposure, the structure of the foresets can still be seen at the south end of the pit. The steep foreset beds, the poor sorting and coarseness of the gravel, and the abundance of cobbles and boulders indicate rapid deposition close to the ice front. The thickness of the delta is about 50 feet, which was about the depth of the lake in this locality.

Near the top of the pit the foreset beds are overlain by a thin bed of laminated silt. This silt bed, which can be traced completely across the pit face, shows the eastward slope of the top of the delta. Similar silt beds occur in most of the Lake Illinois deltas. Deposition of the silt bed marked the end of delta building at this locality. Gravel deposition ceased either because the ice front had melted back or because the direction of outwash discharge from the ice front had shifted to another place. The silt bed indicates deposition at a considerable distance from the delta front.

It has also been suggested that each of the Lake Illinois deltas was formed during a single summer season of melting. The silt beds above the foreset beds are thought to record slow deposition during the winter season of reduced melting.

Sand and gravel, obtained almost exclusively from glacial outwash, are important mineral commodities in La Salle County. Common sand and gravel are used extensively in Illinois for various building and construction purposes. Commercial sand and gravel producers of the state reported a total production of about 38.9 million tons, valued at nearly $40.3 million during 1969.

Leave Stop 10. Retrace itinerary to Route 6. Turn right beyond gate.

0.1	48.6	Turn left.
0.25	48.85	STOP. Intersection with Route 6. CAUTION. Turn left.
0.2	49.05	View of La Salle Limestone quarry at left.
0.1	49.15	Prepare to turn right.
0.2	49.35	Crossroad. Turn right (south).
0.15	49.5	T-road from left. Continue ahead.
0.2	49.7	Abandoned quarries on right and left sides of road.
0.1	49.8	Turn right.
0.8	50.6	Turn right. Entrance to Alpha Portland Cement Company.

Stop 11. La Salle Limestone Member and overlying strata of the Bond Formation (NE¼ and NW¼ NW¼, Sec. 14, T. 33 N., R. 1 E., La Salle County; La Salle 15' quadrangle).

The following paragraphs are extracted from Illinois Geological Survey Bulletin 37, "Geology and Mineral Resources of the Hennepin and La Salle Quadrangles," by G. H. Cady, 1919, p. 65-68:

Of the strata comprising the McLeansboro Formation [Group] the most conspicuous and the most important economically in the [Hennepin and La Salle] Quadrangle is the La Salle Limestone which outcrops along the bluffs of the Little Vermilion, Big Vermilion, and Illinois Rivers in the vicinity of La Salle. The base of the limestone member is arbitrarily taken as the top of a black, fissile shale about 1 foot thick, commonly associated with a seam of coal about 1 inch thick. This black shale forms the floor of the quarry of the La Salle ...Cement Company east of La Salle and appears in the clay pits below the limestone at the quarries of the two cement plants at Oglesby. The limestone terminates below a red, concretionary shale.

The typical La Salle Limestone is found only near the west flank of the [La Salle] Anticline in a strip not much over a mile wide. As found at the cement quarries, it is a succession about 30 feet thick of limestone varying from white, crinoidal, and oolitic strata to brecciated, nodular, dense, thin-bedded layers....These latter beds are associated with different amounts of argillaceous material either between the beds or forming the matrix in which the limestone nodules are embedded. In all places where the limestone is typical it is highly calcareous, but may contain variable amounts of argillaceous material in certain beds. Such silica as is present is that found in [the] finely divided state in the shale or, possibly, in silicates. The rock is essentially non-siliceous.

West from the Vermilion Rivers, the La Salle [Limestone] Member becomes lithologically different because of the amount of argillaceous material in certain beds so that they become essentially shale, and an increase in the siliceous content in other beds so that they are eventually calcareous sandstones or very siliceous limestones....Not all the beds, however, are affected by these changes, some being very pure wherever exposed. This applies especially to the coarser white crinoidal beds.

The stratigraphic succession of the La Salle Limestone Member where it is typical has been compiled from observations at various exposures, at no one of which the section is complete. The sequence is about as follows:

	Thickness (Ft.)	Depth (Ft.)
[Pennsylvanian System		
Bond Formation]		
La Salle Limestone		
7. Limestone, very pure, semi-crystalline, gray; weathering to brownish or reddish color, 5 to 9 feet	6	6

	Thickness (Ft.)	Depth (Ft.)
6. Shale, gray; often entirely absent or incorporated in the underlying bed	2	8
5. Limestone, compact and heavy bedded where fresh, but develops thin beds where weathered. A two-foot bed at the base is relatively constant over the area as a pure semi-crystalline gray limestone	12	20
4. Limestone or shale; south of the Illinois commonly argillaceous, thin bedded; north of the Illinois more argillaceous to nearly a shale	6-8	7-27
3. Limestone, hard, gray, crinoidal. Over large areas about 1 foot thick, but near Vermilion Rivers as thick as 6 feet	2	29

The following section is exposed along the north quarry wall:

	Thickness (Ft.)	Thickness (In.)
Pennsylvanian System		
Bond Formation		
Soil, thin		
Till, light grayish tan, calcareous, pebbly . . .	1	3
Limestone, weathers reddish brown, nodular in lower 10", transitional from shale below, very fossiliferous	1	6
Shale, light grayish tan, fairly hard, blocky, very limy, fossiliferous	2	6
Limestone, light gray, very argillaceous, abundant fossils (almost a coquina in part). Most fossils fragile and difficult to remove	1	3
Shale, dark gray, thinly laminated, fissile; weak-coal horizon?	0	1-2
Clay, medium gray, starchy fracture, underclay type? No plant traces noted	0	7
Shale, medium light gray, soft, plastic, clayey .	1	6
Shale, medium dark gray at bottom; becomes lighter upward. Badly weathered, weak, probably fairly well laminated, does not appear as clayey as some of the other weathered shales here. Grades upward into next unit	4	
Shale, light greenish gray, fairly well laminated but weak; contains numerous small irregular limestone nodules up to 1 1/2" in diameter	1	6
Shale, drab to gray, blocky, weathered; becomes lighter in color toward top	4	
Shale, red, blocky, poorly bedded	5	6
Shale, light gray with slight green cast, more micaceous than below, better bedded; contains finely disseminated pyrite	2	

	Thickness (Ft.)	(In.)
Shale, weathers red, yellow-brown in part; smooth, finely micaceous, hard, discontinuous limy zone up to 3" thick in top 1'. Others may be lower, but difficult to ascertain on weathered clayey surface; fairly well bedded but appears to weather easily. Top 8" contains thin grayish shale streaks	11	6
La Salle Limestone, greenish gray, mottled yellowish to reddish brown, very argillaceous and nodular, especially in lower 3-4". Finely crystalline pyrite masses and balls on top surface	0	8
Shale, greenish gray, poorly bedded, weathered, clayey	1	
La Salle Limestone	22	

Some of the fossils of the La Salle Limestone listed by Cady are given below:

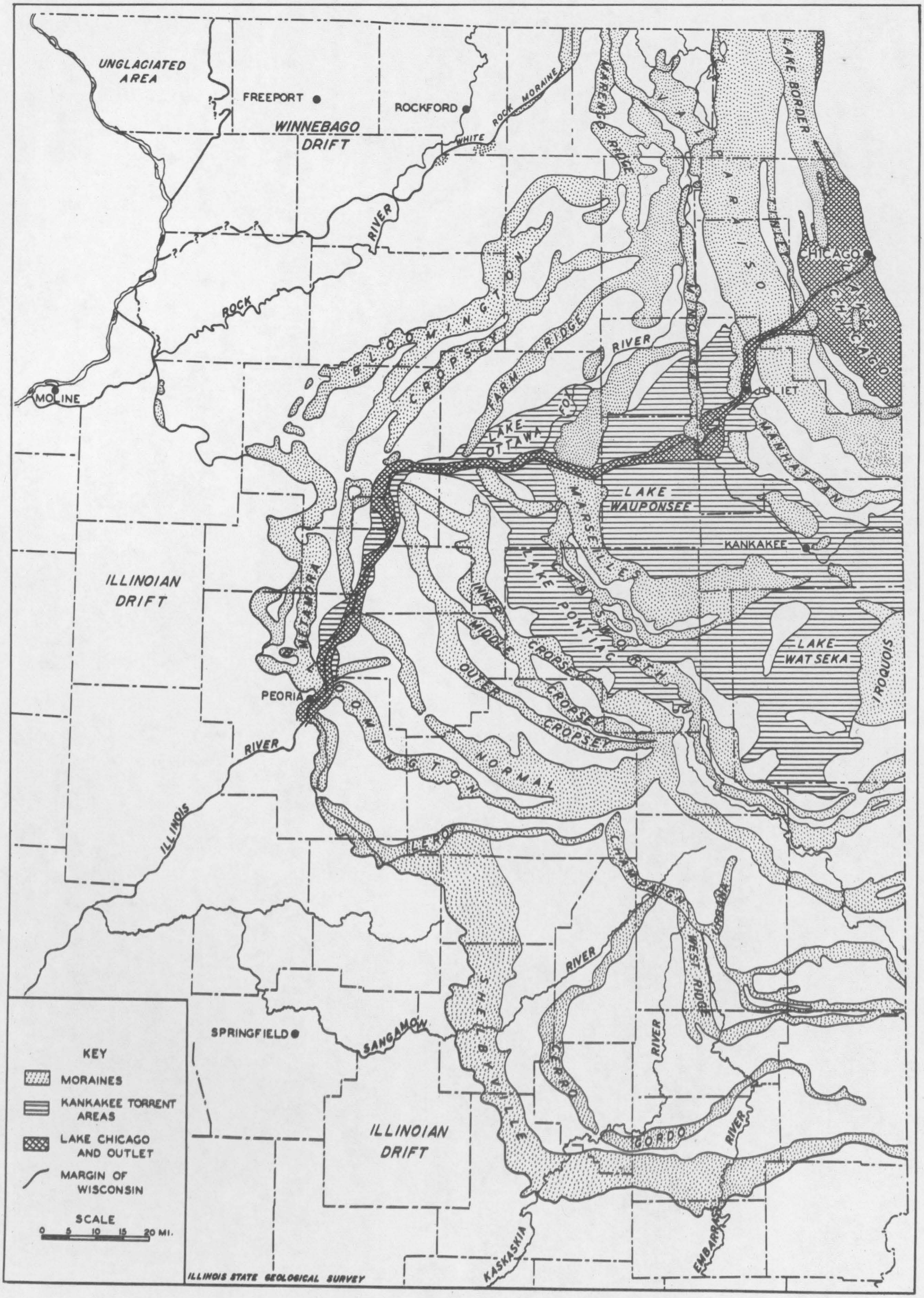
Lophophyllidium profundum
Orbiculoidea subtrigonalis
Rhipidomella pecosi
Meekella straticostata
Chonetes granulifer
Chonetes verneuilianus
Linoproductus cora
Marginifera lasallensis
Marginifera splendens
Juresania nebrascensis
Dictyoclostus semireticulatus
Pustula punctata
Cryptocantha compacta
Dielasma bovidens
Neospirifer cameratus
Ambocoelia planiconvexa
Squamularia perplexa
Punctospirifer kentuckyensis
Composita subtilita

End of Field Trip

TIME TABLE OF PLEISTOCENE GLACIATION

STAGE	SUBSTAGE	NATURE OF DEPOSITS	SPECIAL FEATURES
HOLOCENE	Years Before Present	Soil, youthful profile of weathering, lake and river deposits, dunes, peat	
	7,000		
WISCONSINAN (4th glacial)	Valderan	Outwash, lake deposits	Outwash along Mississippi Valley
	11,000		
	Twocreekan	Peat and alluvium	Ice withdrawal, erosion
	12,500		
	Woodfordian	Drift, loess, dunes, lake deposits	Glaciation; building of many moraines as far south as Shelbyville; extensive valley trains, outwash plains, and lakes
	20,000		
	Farmdalian	Soil, silt, and peat	Ice withdrawal, weathering, and erosion
	28,000		
	Altonian	Drift, loess	Glaciation in northern Illinois, valley trains along major rivers
	75,000		
SANGAMONIAN (3rd interglacial)		Soil, mature profile of weathering	
	200,000		
ILLINOIAN (3rd glacial)	Jubileean	Drift, loess	Glaciers from northeast at maximum reached Mississippi River and nearly to southern tip of Illinois
	Monican	Drift, loess	
	Liman	Drift, loess	
	250,000		
YARMOUTHIAN (2nd interglacial)		Soil, mature profile of weathering	
	600,000		
KANSAN (2nd glacial)		Drift, loess	Glaciers from northeast and northwest covered much of state
	700,000		
AFTONIAN (1st interglacial)		Soil, mature profile of weathering	
	900,000		
NEBRASKAN (1st glacial)		Drift	Glaciers from northwest invaded western Illinois
	1,000,000		

(Illinois State Geological Survey, 1971)



GLACIAL MAP OF NORTHEASTERN ILLINOIS

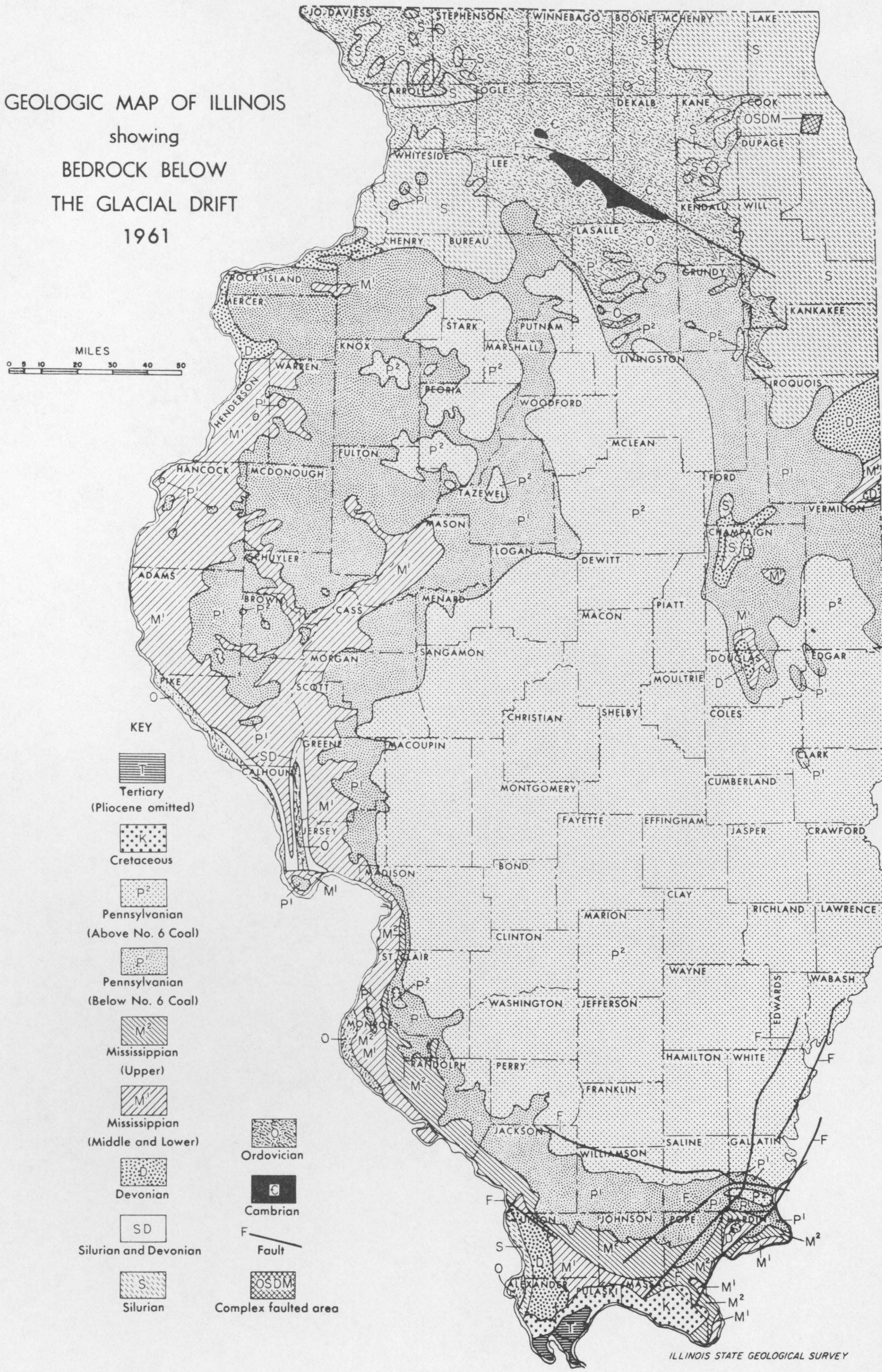
George Ekblaw

Revised 1960

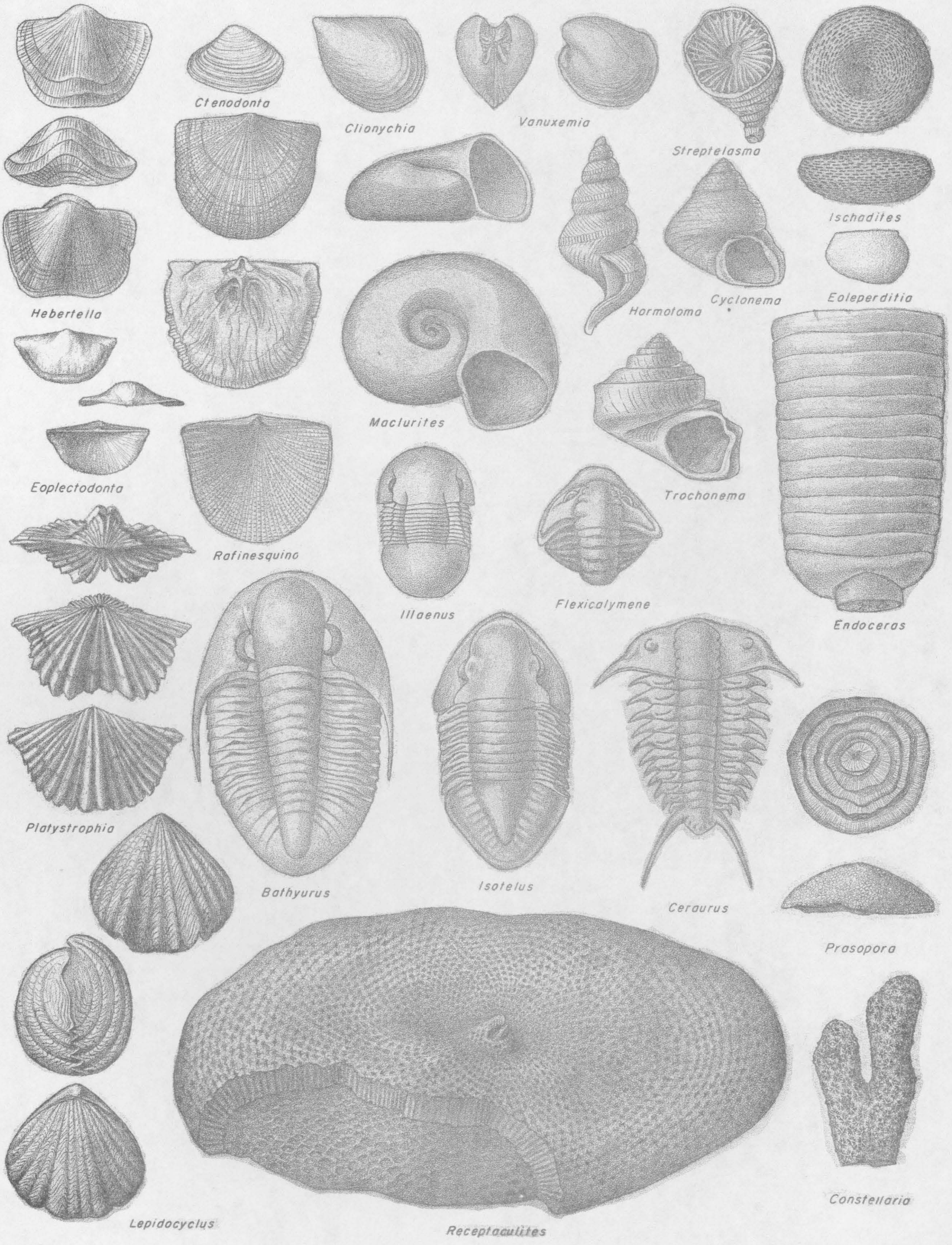
PHYSIOGRAPHIC DIVISIONS OF ILLINOIS

Reprinted 1970

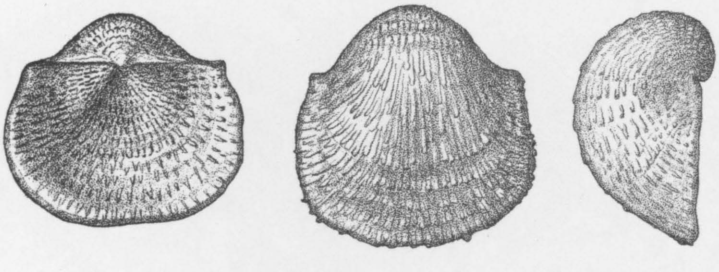
ILLINOIS STATE GEOLOGICAL SURVEY

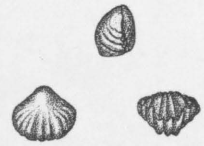

GEOLOGIC MAP OF ILLINOIS
showing
BEDROCK BELOW
THE GLACIAL DRIFT
1961
MILES
0 5 10 20 30 40 50
KEY
Tertiary
(Pliocene omitted)
Cretaceous
Pennsylvanian
(Above No. 6 Coal)
Pennsylvanian
(Below No. 6 Coal)
Mississippian
(Upper)
Mississippian
(Middle and Lower)
Devonian
Silurian and Devonian
Silurian
Ordovician
Cambrian
Fault
Complex faulted area
JO DAVIESS
STEPHENSON
WINNEBAGO
BOONE
MCHENRY
LAKE
CARROLL
OGLE
DEKALB
KANE
COOK
DUPAGE
WHITESIDE
LEE
KENDALL
WILL
HENRY
BUREAU
LASALLE
GRUNDY
ROCK ISLAND
MERCER
KANKAKEE
STARK
PUTNAM
MARSHALL
LIVINGSTON
KNOX
WARREN
PEORIA
WOODFORD
IROQUOIS
HENDERSON
MCLEAN
FULTON
HANCOCK
MCDONOUGH
TAZEWELL
FORD
VERMILION
MASON
CHAMPAIGN
SCHUYLER
LOGAN
DEWITT
ADAMS
BROWN
CASS
MENARD
MACON
PIATT
MORGAN
SANGAMON
DOUGLAS
EDGAR
PIKE
SCOTT
MOULTRIE
CHRISTIAN
SHELBY
COLES
GREENE
MACOUPIN
CLARK
CALHOUN
MONTGOMERY
CUMBERLAND
JERSEY
FAYETTE
EFFINGHAM
JASPER
CRAWFORD
MADISON
BOND
CLAY
RICHLAND
LAWRENCE
MARION
CLINTON
ST CLAIR
WAYNE
EDWARDS
WABASH
WASHINGTON
JEFFERSON
MONROE
HAMILTON
WHITE
RANDOLPH
PERRY
FRANKLIN
JACKSON
SALINE
GALLATIN
WILLIAMSON
UNION
JOHNSON
POPE
HARDIN
ALEXANDER
PULASKI
MASSAC
ILLINOIS STATE GEOLOGICAL SURVEY

ORDOVICIAN FOSSILS



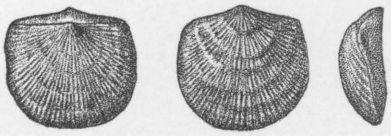
BRACHIOPODS

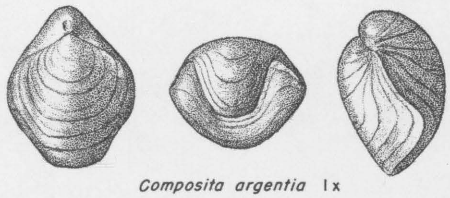




Wellerella tetrahedra 1½ x

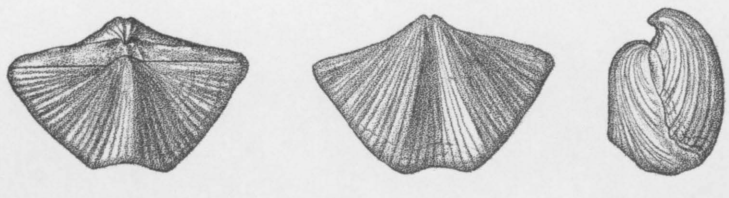
Juresania nebrascensis 2/3 x



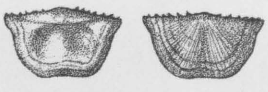


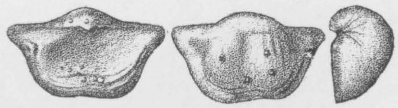
Composita argentia 1 x

Derbya crassa 1 x

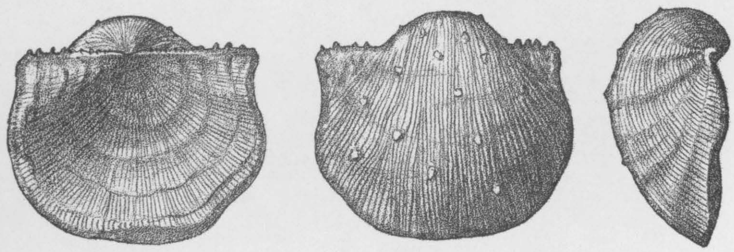


Neospirifer cameratus 1 x





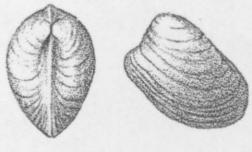
Chonetes granulifer 1½ x *Mesolobus mesolobus* var. *evampygus* 2 x *Marginifera splendens* 1 x



Crurithyris planoconvexa 2 x

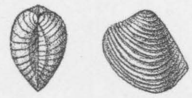
Linoproductus "cora" 1 x

PELECYPODS



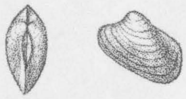
Nucula (Nuculopsis) girtyi 1x

Edmonia ovata 2x

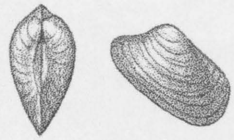


Astartella concentrica 1x

Dunbarella knighti 1 1/2 x

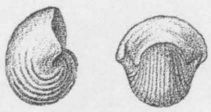


Cardiomorpha missouriensis "Type A" 1x

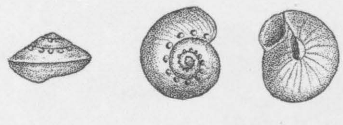


Cardiomorpha missouriensis "Type B" 1 1/2 x

GASTROPODS

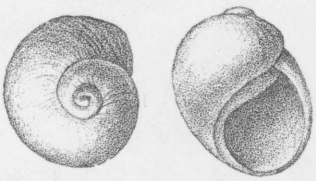


Euphemites carbonarius 1 1/2 x

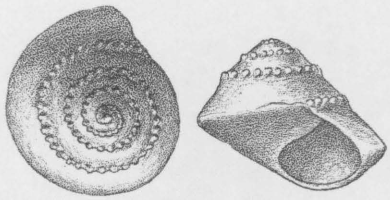


Trepospira illinoisensis 1 1/2 x

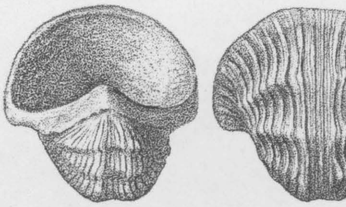
Donaldina robusta 8x



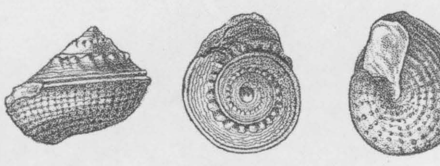
Naticopsis (Jedria) ventricosa 1 1/2 x



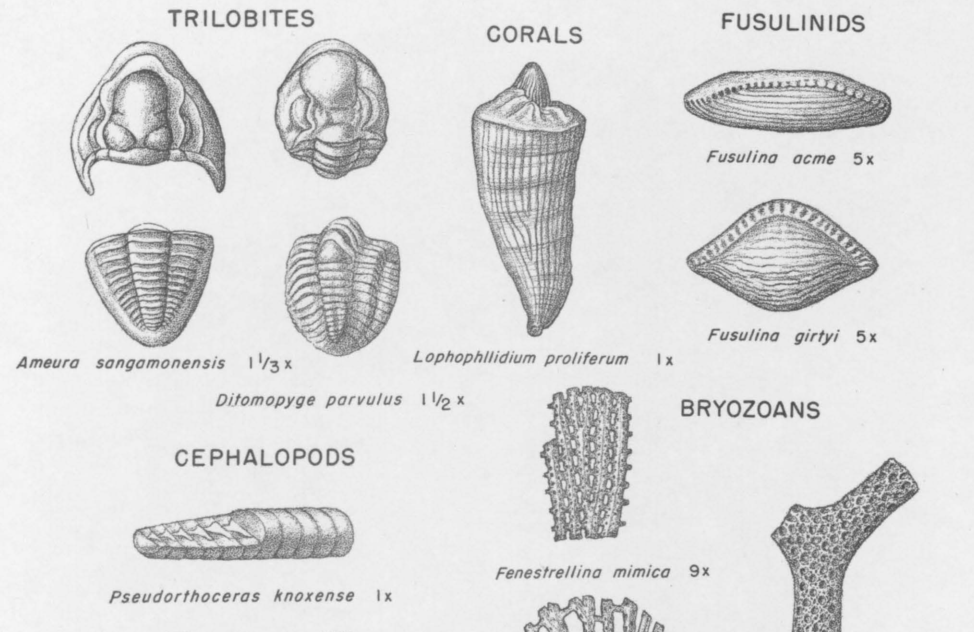
Trepospira sphaerulata 1x

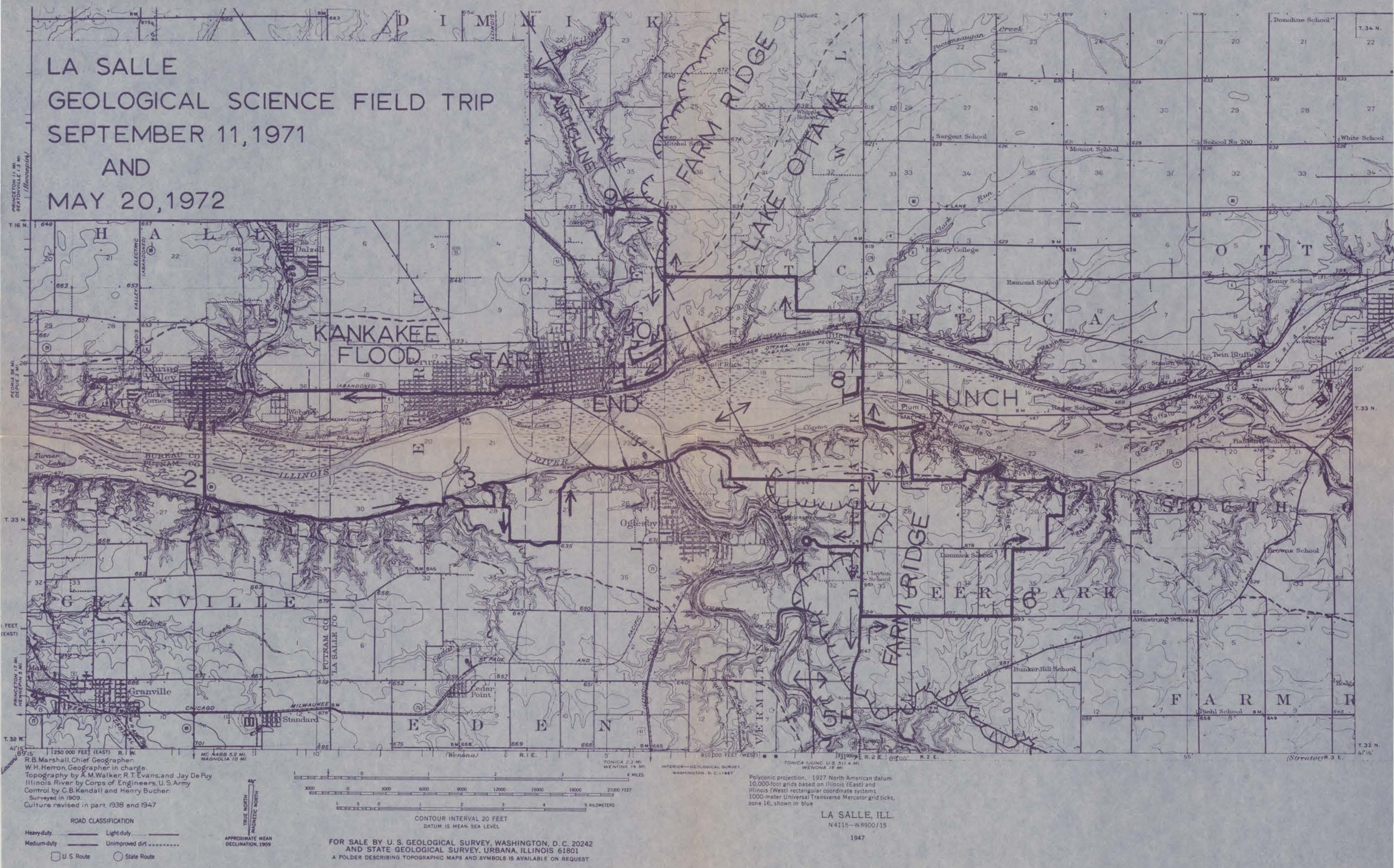


Knightites montfortianus 2x



Glabrocingulum (Glabrocingulum) grayvillense 3x


TRILOBITES
CORALS
FUSULINIDS
Fusulina acme 5x
Fusulina girtyi 5x
Ameura sangamonensis 1 1/3 x
Lophophllidium proliferum 1x
Ditomopyge parvulus 1 1/2 x
BRYOZOANS
CEPHALOPODS
Pseudorthoceras knoxense 1x
Fenestrellina mimica 9x
Glaphrites welleri 2/3 x
Fenestrellina modesta 10x
Rhombopora lepidodendroides 6x
Fistulipora carbonaria 3 1/3 x
Metacoceras cornutum 1 1/2 x
Prismopora triangulata 12x



LA SALLE
GEOLOGICAL SCIENCE FIELD TRIP
SEPTEMBER 11, 1971
AND
MAY 20, 1972
KANKAKEE FLOOD
START
END
LUNCH
FARM RIDGE
LAKE OTTAWA
LA SALLE ANTICLINE
DIMMICK
HALL
UTICA
OTTAWA
SOUTH OTTAWA
DEER PARK
GRANVILLE
EDEN
FARM RIDGE
VERMILION
ILLINOIS RIVER
Oglesby
Granville
Standard
Cedar Point
Dalzell
Spring Valley
R.B. Marshall, Chief Geographer.
W.H. Herron, Geographer in charge.
Topography by A.M. Walker, R.T. Evans, and Jay De Puy
Illinois River by Corps of Engineers, U.S. Army
Control by C.B. Kendall and Henry Bucher.
Surveyed in 1909.
Culture revised in part 1938 and 1947
ROAD CLASSIFICATION
Heavy-duty
Light-duty
Medium-duty
Unimproved dirt
U.S. Route
State Route
APPROXIMATE MEAN DECLINATION, 1909
CONTOUR INTERVAL 20 FEET
DATUM IS MEAN SEA LEVEL
FOR SALE BY U. S. GEOLOGICAL SURVEY, WASHINGTON, D. C. 20242
AND STATE GEOLOGICAL SURVEY, URBANA, ILLINOIS 61801
A FOLDER DESCRIBING TOPOGRAPHIC MAPS AND SYMBOLS IS AVAILABLE ON REQUEST
Polyconic projection. 1927 North American datum
10,000-foot grids based on Illinois (East) and
Illinois (West) rectangular coordinate systems
1000-meter Universal Transverse Mercator grid ticks,
zone 16, shown in blue
LA SALLE, ILL.
N4115—W8900/15
1947